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AN
EXPLANATION AND PROOF
OF
"THE COMPLETE SYSTEM
OF
ASTRONOMICAL CHRONOLOGY,
Unfolding the SCRIPTURES."

IN WHICH
The TRUTH and REALITY
OF THE
ORIGINAL LUNI-SOLAR RADIX

Is clearly and fully ascertained; first, by Calculations à
Priori; then confirmed, to the minutest Exactness, by
Calculations à Posteriori, through an extensive Interval of
5800 Years.

IN A SERIES OF LETTERS
Addressed to Mr. JAMES FERGUSON,
Author of A Treatise of Astronomy upon Sir *Isaac Newton's*
Principles of Philosophy.

Magna est veritas, et prevalebit.

By the Rev. JOHN KENNEDY,
Rector of *Bradley*, in *Derbyshire*,
And Author of the Complete System of Astronomical Chronology
Unfolding the Scriptures.

L O N D O N:
Printed for LOCKYER DAVIS, in *Holborn*,
PRINTER to the ROYAL SOCIETY.

MDCCLXXV.

EXPLANATION AND CHARTS

7-11-63 H F U A T 311



A N

EXPLANATION, &c.

To Mr. James Ferguson.

L E T T E R I.

Old Friend,

A MUSING myself, at a leisure hour, with the great variety of matter interspersed throughout your Treatise of Astronomy, 2d Edition, (compiled, as you inform your readers, from the best authorities of the present age) and revolving in my mind the wondrous depths of scientific knowledge, the contents of a very distinguished section, p. 198. made such a forcible impression, as allured me to dwell the longer upon it; and I now cite it with a sensible satisfaction, and with no small prejudice in its favour.

Ferguson's Astronomy, 2d Edition, p. 198.

“ If it could be proved, from the writings of
“ Moses, that the sun was created on the point of
“ the autumnal equinox, and the moon, in oppo-
“ sition, on the fourth day of the creation-week, there
“ would be data enough for ascertaining the age of
B “ the

“ the world: for suppose the moon to have been
 “ full on an equinoctial day, which was the fourth
 “ day of the week, it would require many thou-
 “ sands of years to bring these three characters
 “ together again.”

This section represents to our mental view, with great judgement, art, and skill, an astronomical coincidence in the utmost perfection of mathematical exactness; for it leads us to contemplate a 24-hours day, commencing at the moment of full moon, on our Wednesday at noon, in a certain meridian; and terminating at the moment of the sun's entry into the first point of Libra, in the following noon, on our Thursday, in the same meridian.

It may be questioned, whether it be in the indefinite power of numbers to determine the precise period, in the completion of which this identical combination of characters can return again: it is certain to a demonstration, that they have never met together twice, in the same meridian, since the creation, even if we could suppose more than 600,000 annual revolutions of the sun to have passed.

I shall not stay to enquire, from what authority, whether human or divine, you received these admirable luni-solar characters; or from what fountain you derived them, whether an earthly or a heavenly one. Let it suffice, if you find me well able to prove to you, that this luni-solar radix (whose intrinsic value is inestimable) is not only true in nature, but in real fact; and that the very individual year of the current Julian period, in which only it can be found, may be discovered: and the above-mentioned four characters, respecting the sun, the moon, the day of the week, with the moment of full moon, and of the autumnal equinox, in a determinate meridian, may be perfectly ascertained by calculation.

But here I must not omit to remark, that the tabular measures, which are to regulate and direct such extraordinary calculations, must be as mathematically true,

true, as the given luni-solar characters themselves are: i. e. they must be without the excess or defect of a single moment of time, as if they were immediately derived from the heavens themselves.

Here probably it may be objected, that such a rigorous limitation and restriction, such a wild and romantic accuracy, as is here prescribed, nay, and which Mr. Ferguson himself, in explicit terms, disclaims all pretensions to, can only tend to discourage the most experienced and skilful calculator, even from making the attempt. And indeed it must necessarily produce such an effect, if we attentively consider, and closely examine, the present state and condition of our tables in common use: for although they are far from being few in number, yet, if we compare them, we shall have the dissatisfaction to find, that they all disagree with each other. From this general disagreement it is certain, that they cannot be all of them precisely true; and the difficulty is, to determine which of them is incontrovertibly so.

But fearing lest what I have hinted, concerning the disagreement of our common tables with each other, may be censured as an invidious insinuation, and I may thereby incur your displeasure, I will give you ocular proof of it, by collecting and laying together a few examples from the best authorities extant, then leave you to form your own judgment.

TABLE I.

Exhibits three assigned lengths of a Tropical Year, with the respective Authorities annexed.

	D.	H.	'	"	'''	
1.	365	5	48	57	00	Sir Isaac Newton, and Ferguson's Astronomy, 1st and 2d Edition.
2.	365	5	48	55	00	Dr. Halley, and Ferguson's Pamphlet, p. 5.
3.	365	5	48	56	21	Ferguson's deduction from the apparent Motion of the Sun in the Ecliptic.— <i>Crit. Review, for May, 1763.</i>

TABLE II.

Exhibits three assigned lengths of a mean Luration, with the respective Authorities annexed.

	D.	H.	'	"	'''	'''	5ths	6ths	
1.	29	12	44	3	15	00	00	00	Ferguson's Astronomy, 2d Edit, p. 229.
2.	29	12	44	3	2	58	00	00	The Rev. Dr. Pound, and Fer- guson's Pamphlet, p. 4.
3.	29	12	44	2	53	25	23	25	The late Professor Meyer of Gottingen.

Now, permit me, without offence, to state a possible case to you. Suppose that, in your public capacity of a Table-maker, you was enjoined, by authority, to select out of this triple variety, some one length of a tropical year, from Table I. and likewise some one length of a mean luration, from Table II. with a request to prove, that this selected length, both of the tropical year, and of a mean luration, was nearer to a mathematical exactness, than any other, which the most eminent professor had ever yet given a sanction to. Then I ask,

1st, Which of them would your judgment direct you to make choice of?

2dly, Upon what principles, and by what means, would you propose to gratify a request, which, by the supposition, it was not in your power to decline?

A civil answer to these plain, but important queries, would, perhaps, help me to apprehend the real meaning and intent of the following extracts from the Critical Review, signed,

JAMES FERGUSON.

Critical Review for May, 1763, p. 329.

" Our author (K. the Chronologist) complains of
" being unable to find the exact length of the tropical
" year, from the observations of the best astronomers;

" as

“ as if to them it was yet amongst the hidden secrets
“ of nature.”

—See it proved, Table I. even to a demonstration, from Mr. Ferguson’s threefold authority, that the exact length of the tropical year can by no means be reckoned amongst the inaccessible secrets of nature, since he himself knows it perfectly well, and is able to define it precisely by no less than three *disagreeing* terminations.

Such slight grounds had our impertinent Chronologist for raising such an outcry about uncertainty.

“ But in many places of his book he tells us, that
“ he has not only found out the length of the tropical
“ year, even to a mathematical precision, but also the
“ length of a mean lunation to the same degree of
“ exactness.”

—And what our Chronologist tells us, may every jot and tittle of it be true, for any thing our critic has proved to the contrary.

“ And all this, without having ever made so much
“ as one single celestial observation.”

—If our acute critic has ever made more than one single celestial observation, how comes it to pass, that he has not given us his own observed length of the tropical year, and his own observed length of a mean lunation? This demands an answer.

Critical Review for November, 1763, p. 344.

“ I own that my last Astronomical Tables are not
“ exactly the same with my first. I do not pretend
“ that these Tables are yet perfect, or that they ever
“ can be brought to such a degree of exactness, as
“ you assert all your Tables and calculations are—But
“ you are a perfect man in all these things; your
“ measures of years, lunations, sidereal and solar days,
“ are all so mathematically true, that the least particle
“ of

“ of time, can neither be added to them, nor taken
 “ from them, without offering violence to nature.”
 —JAMES FERGUSON.

Horace puts it by way of question,

“ ————— Ridentem dicere verum
 “ Quid vetat ?”

Which I would thus translate.

What should hinder a man, Mr. Ferguson, for
 example, to speak a true word in jest ?

I will freely own to you, that upon my perusal of
 these extracts, I was not a little perplexed from my
 not being able to discover, in what particular light I
 was called upon to consider them,—Whether, as a
 reproof of my vanity, or, as a public impeachment
 of my ignorance, or, as a generous compliment paid
 to my extraordinary performances and superlative abi-
 lities, or, only as a sportive figure in rhetoric, called
 irony ; it being well known, that,

“ Contra quam sentit solet Ironia joculari.”

Whether these, my conjectures, are well or ill
 grounded, it is in your power, by a few words civilly
 expressed, to relieve, at once, from a very perplexing
 uncertainty,

October the 11th,
 1774.

Your old acquaintance,
 And well wisher,

JOHN KENNEDY.

LETTER

To Mr. James Ferguson.

L E T T E R II.

AS my System of Chronology has never yet been so fortunate as to fall into the hands of a candid, judicious, and unbiaſſed examiner, who might be thought either able or willing to do it ſtrict juſtice, by giving the reader a diſtinct and adequate view of its principles and its proof, owing, it may be, to an over-eager deſire to refute the Aſtronomical part of it; I have thought it extremely expedient, I might have ſaid, quite neceſſary, to ſupply this viſible defect, by giving a ſuccinct account, myſelf, of its immediate tendency and deſign, before I proceed to what I have to offer in ſupport of its truth.

I need not obſerve, what you know very well, that there is a great diverſity of opinions concerning the æra of the creation, and the true current year of the world: it would be quite tedious to enumerate the many different computations, not any two of which agree together: and the many different judgments of the learned in every ſucceſſive age, ſince the commencement of the Chriſtian æra, both for and againſt the practicability of ſuch a reſearch. Therefore, to avoid prolixity, I ſhall only juſt mention two or three.

Abp. Uſher, in the Preface to his Annals, hesitates not to reckon ſuch an enquiry, inter καλεπα, ſed non inter αδυνατα. He admits it to be difficult, but not impoſſible.

In ſome other paſſages he ſeems to animate the enquirer with a well-grounded hope of certainty; as, to omit others, in the following one.

—“ Hoc conceſſo, quod rationi maximè eſt conſentaneum, ſcriptores ſacros tantâ diligentia annorum
“ numeros

“ numeros suis in locis conflagantes, id sibi habuisse
 “ propositum, ut annorum mundi seriem, *quæ aliunde*
 “ *disci non poterat*, nobis patefacerent.

Every reader must acknowledge, that the sentiment here expressed must exempt the most diligent researcher from the imputation, either of unwarrantable presumption, or of absurdity,

From Usher we will pass to David Paræus, as we find him cited in the same Preface. This learned critic delivers his opinion, concerning impracticability, in very peremptory, and some may think, in very exaggerated terms. Thus he writes.

“ Tempus Astronomicum, a primo creationis puncto,
 “ ad principium æræ Christianæ exactum, qui se dare
 “ nobis posse promittunt, favore mihi digni videntur
 “ magis quam laude, quia—Majus quid Humano
 “ Ingenio moliuntur.”

Such a peremptory declaration, from so learned a critic, is enough, one would think, to damp the courage of a Hercules; and effectually prevent him from ever engaging in such an arduous and unpromising undertaking, could it not be contrasted by several others of good authority, and much more moderate ones.

Notwithstanding these many and great discouragements from the disagreement of computations, and the difference of judgments, curiosity still prompted me to try, if such an uninterrupted series of years could not be collected from the evidences of sacred and profane history, as might be confirmed and established by Astronomical arguments, which terms you have happily explained to the full extent of their meaning, in the above-mentioned section, p. 198. as follows.

“ Supposing the moon to have been full upon an
 “ equinoctial day, which was the fourth day of the
 “ week, it would require many thousands of years
 “ to bring these three characters together again.”

Such

Such arguments appeared to me so conclusive and unanswerable, that whoever should go about to invalidate them, would but betray his own ignorance, and throw away his time; and that very little more was wanting, besides a true luni-solar radix, a true chronological series of years, and tabular measures accurately true, whereby to calculate these astronomical coincidences, (upon which the arguments are founded) in all their minutiae and varieties.

In the Preface to the 1st volume of the Universal History we meet with no less than ninety-eight discordant computations of the interval between the supposed year of the creation and the beginning of the vulgar Christian æra. Out of these I shall take only those of Archbishop Usher's; and I take those, because the public has so far given the sanction of its judgement to them, as to dignify them with a place in the margin of our Bibles; and because I find that the learned Dr. Blair has made choice of them, upon which to construct his Chronological Tables.

Archbishop Usher published his Annals, as appears by the title-page, A. D. MDCLXXXVI.

At the distance of forty-four years after this date, namely, MDCCXXX. the Reverend Mr. Bedford put forth a large Treatise in folio, upon the subject of Scripture Chronology; in which he has attempted to verify the times of the most remarkable events in sacred history, by tabular calculations; and, had his tables been less defective, he might have met with a more full success.

At the distance of thirty-one years after the foregoing date, namely, A. D. MDCCLXI. I ventured to publish a pretty large volume in quarto upon the same subject, but upon a plan quite different from all that had gone before me. My calculations are under the constant directions of original principles, and scriptural astronomical data; the truth and reality of which have never yet been invalidated.

I shall add further, that my chronological tables are filled up with a long uninterrupted series of no less than 5768 single tropical years; whereas Dr. Blair begins to reckon his series of single Julian years from an æra no higher up in time than that of the Olympiads: as if 3232 scriptural tropical years were of so little account, that they might be slightly passed over, or digested into complete centuries, without any apology to the scripturist, as trivial and unmeaning things. This seems, methinks, to carry along with it the air of an Olympic, rather than of a Scripture chronologist.

As a true uninterrupted series of Julian and tropical years must necessarily be reckoned amongst the fundamentals, I might have said, the pillars upon which a system of chronology is built, I shall take this occasion to shew, how 3446 scriptural tropical years may be rightly collected, in the interval between the year of the creation and the death of Nebuchadnezzar the Great; although Archbishop Usher collects, in that interval, no more than 3442 Julian years.

A TABLE of the WORLD'S CHRONOLOGY,

As computed by Archbishop Usher, the Reverend Mr. Bedford, and myself; in which the distinct computations are marked with these initial letters, U. B. K.

Intervals.	U.	B.	K.	A.M.	U. B. K.
1. From the creation to Noah's flood —	Yrs. 1656	Yrs. 1656	Yrs. 1656	1656	
2. From Noah's flood to the 70th year of Terah, in which his eldest son was born	292	292	292	1948	
3. To the birth of Abram —	60	60	60	2008	
4. To the call of Abram out of Ur of the Chaldees —		74	74	2082	A.M.
4. To the departure of Abram out of Haran	75				U. 2083
5. To the Exodus —	430	430	430	2512	2513
6. To the laying the foundations of the temple —	480	480	480	2992	2993
7. To the death of Solomon —	36	36	36	3028	3029
8. To the erecting the golden calves —		2'	1	3029	3030
9. To the burning of the temple inclusive	387	390			3420 3416
9. To the burning of the temple exclusive			390	3419	
9. To the burning of the temple inclusive			1	3420	3420 * 3416
10. To the death of Nebuchadnezzar the Great —	26	26	26	3446	3446 3442
11. To the year of Christ's birth o —	561	561	561	4007	4007 4003
12. To the current year of our Lord —	1774	1774	1774	5781	5781 5777
13. To A. D. 1793 —	19	19	19	5800	5800 5796

It appears from these Tables, 1st, That two of the three computists, namely, B. and K. exactly agree

C. 2

in

* Difference 4 Years.

the sum total of years; and that the only visible difference lies in the placing of a single year; for whereas they both of them collect 392 years, in the interval between the death of Solomon and the burning of the temple, it seems to be a matter of doubt, whether the collected sum must be placed in this order, 2 + 390, as directed by B; or in this order, 1. 390. 1, as directed by K. And indeed this is such a material point, as well deserves a critical discussion; since the wrong placing of a single year, must necessarily destroy astronomical synchronism, wherever it is found, as it thereby disorders the natural course of the years. A positive proof might be given of this.

It evidently appears, 2dly, that the joint computations of B. and K. conspire to detect a metachronism of four years in Usher's collection, in the interval between the death of Solomon and the burning of the temple. May it not therefore be worth Dr. Blair's while attentively to examine this interval, as the verity of his Chronological Tables is so much interested in it; and thereby to learn how to adjust rightly the collateral reigns of the kings of Judah and Israel? an adjustment, which we may look upon and admire as a most ingenious chronological contexture; and likewise as a most highly valuable astronomical monument of antiquity.

Having stated and defined this fundamental article; if we suppose a calculation to be made backward from the autumnal equinox, A. D. 1793, through a series of 5800, and likewise of 5796 years, the former will terminate at the autumnal equinox, A. M. 0, according to the joint computations of B. and K; and the latter at the autumnal equinox, A. M. 0, according to the computations of U.

But perhaps these calculated conclusions may be more clearly apprehended from the annexed table.

B. K.	Interval	U.
	four	
A. M. 0	years.	A. M. 0
⊙		⊙

We have here two distinct epochs of time: the one is carried four years, either real or imaginary, higher up than the other; and the enquiry must be which of them is the true one. I am to determine this question by calculation, which will furnish a proper subject for another letter.

To Mr. James Ferguson.

L E T T E R III.

I Have taken upon me to determine, by calculation, which of the two epochs, as set down in the foregoing table, is the true epoch of time: but let it be observed, that these terms—the True Epoch of Time—imply nothing less than the true luni-solar characters of the world's æra; in other words, the very position of the sun and moon to each other at the very instant of their creation; which, had it not been a scriptural datum, could never have been ascertained by the acutest penetration of the human mind; non sagacissimæ ingenii Newtoniani vi.

Dr. Blair, at the top of the first page of his Chronological Tables, Plate I. has set down a few dates, (and they may possibly be the very few data which he so slightly mentions in his preface) which seem to be given with an intention, that the reader should consider them as original principles, and the true, although not luni-solar characters of Archbishop Usher's æra of the creation. These so few data are as follow.

“A. J. P. 710. The æra of the creation, according to
 “Archbishop Usher, began on Sunday, the 23d day of
 “October, in the year before the vulgar æra of Christ's
 “birth, 4004.

“Adam and Eve were created on Friday the 28th
 “of October.”

From

From this last date it follows, that according to Archbishop Usher's hypothesis, Saturday must have been the original Sabbath, as it is to this day religiously kept by the Jews.

From this account of the æra of the creation, we will frame

TABLE I.

In which the days of the first week are unastronomically and Judaically computed.

Julian. M. D.	Literal characters.	Days of the week.	Numeral characters.
Oct. 23	B.	Sunday.	1 η πρωτοκτιστη ημερα.
24	C.	Monday.	2
25	D.	Tuesday.	3
26	E.	Wednesday.	4
27	F.	Thursday.	5
28	G.	Friday.	6 Adam and Eve created.
29	A.	Saturday.	7 Original Sabbath.

Upon a view of these seven days of the first week, thus unastronomically adjusted, and thus Judaically computed, I will be bold to say, that should the most zealous abettor of Archbishop Usher's collection of a series of 3442 Julian years, in the interval between the year of the creation, and the death of Nebuchadnezzar the Great, incessantly pore over Table I. till his eye-sight began to fail him, and he found himself decrepit with old age, he would not be able to determine, without the assistance and direction of some one express scriptural principle or datum, on which of these seven days the sun came to the autumnal equinox, or whether immediately after a new or full moon, or at what precise distance.

Leaving therefore the ingenious Dr. Blair to make what advantage he can of his unastronomical and Judaical table, (and if he can make any, it is more than I have been able to do with the utmost exertion of my abilities) I shall assume the liberty to substitute, in its stead,

TABLE

TABLE II.

Which arranges the days of the First Week astronomically, and as they are to this day computed by the Christians, making Sunday the seventh day, and the original Sabbath.

Julian M. D.	Literal characters.	Days of the week.	Numeral characters.
October 22	A.	Monday.	1
23	B.	Tuesday.	2
F. moon 24	C.	Wednesday.	3 F. moon 0 h. 0 m. 1st merid.
☉ in ♈ 25	D.	Thursday.	4 ☉ in Libra 0 h. 0 m. 1st merid.
26	E.	Friday.	5
27	F.	Saturday.	6
28	G.	Sunday.	7 Original Sabbath.

In order to render the subsequent calculations the more intelligible, instead of A.M. 0, I shall set down the respective years of the Julian period, and then the table will appear as follows.

B.K.	Interval	U.
A. J. P. 706	4 years.	A. J. P. 710
☉		☉

Here the several points of enquiry must be,

I. On what day of the Julian month October, at what hour and minute, and on what day of the week, did the sun come to the autumnal equinox, A. J. P. 710?

1st, In the first meridian; 2dly, in the meridian of the Greenwich observatory; 3dly, in a meridian which lies 6°, or 222 English statute miles, westward of Greenwich, in the same latitude.

II. Whether a new, or full moon, came next before this autumnal equinox, and at what precise distance?

III. On what day of the same month, at what hour and minute, and on what day of the week, did

did this autumnal-equinoctial new moon, or full moon happen, in the same meridians?

IV. I am to prove, to the precision of a moment, the truth of these several particulars, being first ascertained *à priori*, by a calculation backward, through a series of 5800, and of 5796 Julian and tropical years, taking for a radix that m. new or full moon, which will come the next after the autumnal equinox, A. D. 1703.

Here follows

A Calculation of the First Point of Enquiry.

The interval is 4 tropical years, which give by reduction 1460d. 23h. 16m. P.M. The hours being reduced to midnight, we shall have 1461d. 11h. 16m. A. M.

These 11h. 16m. A.M. express the moment of the autumnal equinox in the first meridian.

2dly. To 11h. 16m. A.M. add 10h. 24m. for the difference of longitude in time, between the first meridian, and the meridian of the Greenwich observatory; then from the sum 21h. 40m. subtract 12h. and the remainder 9h. 40m. P.M. will be the hour and minute of the autumnal equinox at Greenwich, A. J. P. 710.

3dly, To 11h. 16d. A. M. add 10h. for the difference of longitude in time, between the first meridian, and that meridian which lies 6° westward of Greenwich; then from the sum 21h. 16m. subtract 12h. and the remainder 9h. 16m. P.M. will be the hour and minute of the autumnal equinox in the third given meridian.

Required the day of the Julian month, and the corresponding day of the week, on which the sun came to the autumnal equinox, A. J. P. 710, in the three given meridians?

The CALCULATION.

Divide 1461d. by 7, then to the remainder 5 add from Table II. the numeral character 4, from the sum 9 subtract 7, and the remainder 2 will be the numeral character of Tuesday.

The dominical letter for the A. J. P. 710 was B. count from B. exclusive, two literal characters forward, namely, C. D. and we shall find D. over-against October 25, which is the day of the Month; and D. for that year, denoting Tuesday, is the day of the week required.

We say then, that A. J. P. 710, the sun came to the autumnal equinox.

D. H. M.

1st, On Tuesday, Oct.	25	11	16	A. M.	In the 1st meridian.
2dly, ——— ———			9	40	P. M. At Greenwich.
3dly, ——— ———			9	16	P. M. In the 3d given merid.

The truth of all these particulars, being thus ascertained à priori, must be confirmed to the precision of a moment, by calculations à posteriori.

A CALCULATION

Of the Second Point of Enquiry, namely, whether a New Moon, or a Full Moon, came immediately before this Cardinal Point, and at what precise distance?

Looking into 'Table II. p. 8. I find a full moon at the distance of 1 entire day before ☉ in ♌; from hence I infer with certainty, because by an invariable law, that at the end of the fourth year following, a new moon would come next before ☉ in ♌: but at what precise distance before it, may be readily known from the subjoined table, accurately, though covertly, expressing the gradual decrease of the epacts: terms which will be clearly understood in the course of the present operations.

D

The

The difference between the tropical solar, and a mean lunar year, is 10d. 21h. 00' 39" 00": add this number to itself 4 times, and when the amount is more than a whole lunation, throw it off, and we shall have a table for 4 years, equal to the interval. *E. g.*

Index.	D.	H.	'	"	'''
1 —————	10	21	00	39	00
2 —————	21	18	1	18	00
3 —————	3	2	17	55	15
4 —————	13	23	18	34	15

In the same parallel line with the Index 4, we find these times, namely, 13d. 23h. 18' 34" 15"', which being subtracted from 14d. 18h. 22' 00" 52" 30"', half a mean lunation, will leave, in remainder, 19h. 3' 26" 37" 30'''. This remainder, thus obtained, not only informs us with great accuracy, how much the original full moon epact is decreased, namely, 19h. 3' 26" 37" 30"', but also, its numbers would have accurately expressed the very moment of m. new moon in the first meridian, provided the sun had invariably entered the point of the autumnal equinox at noon in the same meridian: for reducing the hours to midnight, by subtracting 12h. from 19, then the M. time of new moon, in the first meridian, would have been 7h. 3' 26" 37" 30''', A. M. but because the sun enters the cardinal points 11' earlier every year, from 7h. 3', subtract 44' for the retrocessions in 4 years; then we shall have 6h. 19' 26" 37" 30''', A. M. for the exact M. time of new moon, in the first meridian.

2dly, To 6h. 19' add 10h. 24'; then from the sum 16h. 43', subtract 12h. and the remainder, 4h. 43' 26" 37" 30", P. M. will be the M. time of new moon next before ☉ in ♈, at Greenwich, A. J. P. 710.

3dly, To 6h. 19' add 10h. then from the sum 16h. 19', subtract 12h. and the remainder 4h. 19' 26" 37" 30"', P. M. will be the M. time of new moon, in the third meridian.

We

We say then, that A. J. P. 710, the M. time of new moon next before ☉ in ♈, was,

	D.	H.	'	"	'''	'''	
1st, On Tuesday, Oct. 25	6	19	26	37	30		A. M. in the first meridian.
2dly, ——— —	4	43	26	37	30		P. M. at Greenwich.
3dly, ——— —	4	19	26	37	30		P. M. in the 3d given meridian.

IV. I am to prove, to the precision of a moment, the truth of these several particulars, being first ascertained à priori, by a calculation backwards, through a series of 5800, and of 5996 Julian and tropical years, taking for a radix that M. new moon which will come next after the autumnal equinox, A. D. 793.

But before I enter upon this fourth article, I must go back, and satisfy the latter part of the Second Point of Enquiry, namely, at what precise distance did this M. new moon come before ☉ in ♈, A. J. P. 710?

The CALCULATION.

	H.	'	"	'''	'''	
From 24 00 00 00 00						The distance of the original full moon before the original autumnal equinox,
Subtract for the quadri- ennial decrease of the full moon epact	19	3	26	37	30	P. M.
The astronomical new- moon epact	4	56	33	22	30	or M distance of new moon before ☉ in ♈, A. J. P. 710.

The PROOF.

	D.	H.	'	"	'''	'''	
From Oct. 25	11	16	00	00	00		A. M. ☉ in ♈ 1st merid.
Subtract the M. time of new-moon	6	19	26	37	30		A. M. before ☉ in ♈ 1st merid.
The new-moon epact, as above	4	56	33	22	30		
	D 2						2dly,

$$\begin{array}{r}
 \text{2dly,} \quad \text{From Oct. 25} \quad \text{D. H. } \begin{array}{cccc} 9 & 40 & 00 & 00 \end{array} \text{ P. M. } \odot \text{ in } \simeq \text{ at} \\
 \text{Greenwich.} \\
 \text{Subtract the M. time of } \left. \begin{array}{l} \text{new-moon} \\ \text{The new-moon epact,} \\ \text{as above} \end{array} \right\} \begin{array}{r} 4 \ 43 \ 26 \ 37 \ 30 \\ \hline 4 \ 56 \ 33 \ 22 \ 30 \end{array} \left\{ \begin{array}{l} \text{P. M. before} \\ \odot \text{ in } \simeq \text{ at ditto.} \end{array} \right.
 \end{array}$$

$$\begin{array}{r}
 \text{3dly, From Oct. 25} \quad \text{D. H. } \begin{array}{cccc} 9 & 16 & 00 & 00 \end{array} \text{ P. M. } \odot \text{ in } \simeq \text{ 3d merid.} \\
 \text{Subtract the M. } \left. \begin{array}{l} \text{time of new-} \\ \text{moon} \end{array} \right\} \begin{array}{r} 4 \ 19 \ 26 \ 37 \ 30 \\ \hline 4 \ 56 \ 33 \ 22 \ 30 \end{array} \left\{ \begin{array}{l} \text{P. M. before } \odot \text{ in } \simeq \text{ 3d} \\ \text{merid.} \end{array} \right. \\
 \text{The new-moon } \left. \begin{array}{l} \text{epact, as above} \end{array} \right\}
 \end{array}$$

We say then, that A. J. P. 710, the M. new moon happened 4h. 56' 33" 22''' 30'''' before the autumnal equinox; which was to be proved.

We must now proceed to Article IV. the several particulars of which are of such singular importance, as may well require some more than ordinary pains and care, as well as art and skill, to verify them.

I am to make a backward calculation, taking for a radix that M. new moon, which will come next after the autumnal equinox, A. D. 1793. But the grand impediment lies here; the calculations, by means of which this radical new moon is to be found, will themselves require a radix; for no calculations can be made, without the assistance of radical numbers; i.e. without a sure connection with some principle as true as nature, *known afore*.

In order to obtain this necessary radix, I look into Table II. p. 15. where I find a full moon on the 24th of October, oh. om. Therefore,

$$\begin{array}{r}
 \text{From Oct. 24} \quad \text{D. H. } \begin{array}{cccc} 00 & 00 & 00 & 00 \end{array} \\
 \text{I subtract for } \frac{1}{4} \text{ a M. lunat. } 14 \ 18 \ 22 \ 00 \ 52 \ 30 \\
 \hline
 \text{The remainder will } \left\{ \begin{array}{l} \text{give for M. time of} \\ \text{new-moon} \end{array} \right. \text{Oct. 9} \ 5 \ 37 \ 59 \ 7 \ 30 \text{ P. M. next before} \\
 \odot \text{ in } \simeq, \text{ 706,} \\
 \text{1st meridian.} \\
 \text{I form}
 \end{array}$$

I form these numbers into a table for 4 years, which may easily be done, by only adding 6 to the hours successively; and then it may be entitled

A Table of Radical Numbers, for the more easy and accurate calculation of autumnal equinoctial M new moons, in any given meridian, and in any given year, either before or after the vulgar Christian æra, without any limitation of Time.

D. H. ' "'''

A. J. P. 706, after Bifext. 1 Oct. 9 5 37 59 7 30 P. M. new-moon,
1st meridian.

2	9	11	37	59	7	30
3	9	17	37	59	7	30
0	8	23	37	59	7	30

Having thus far prepared the way, I must, in the next place, investigate such an astronomical number, as may be adequately commensurate to the distance between new moon in October, A. J. P. 706, which we may now call the *Terminus à quo*; and the radical new moon in September, A. D. 1793, which we may now call the *Terminus ad quem*.

But such an adequate astronomical measure may be readily obtained by a short and easy calculation, as follows.

5800 Julian years produce 2118450d. 00h. 00m.

5800 tropical years include 71737 lunations, which produce 2118434d. 22h. 00' 19" 45'''

	D.	H.	'	"	'''
From the Julian reduction	2118450	00	00	00	00
Subtract the lunar, less by 1 day	2118433	22	00	19	45
The astronomical measure required	16	1	59	40	15

The APPLICATION.

A. D. 1793, will be the first after bifextile; therefore the radical numbers are October 9d. 5h. 37'—Add, to make the subtraction, the 30 days of September, and the sum will be 39d. 5h. 37'.

From

(22)

D. H. ' " " "

From 39 5 37 59 7 30 P. M. new moon Oct. 1st
merid. A. J. P. 705.

Subtract for the astro-
nomical measure. } 16 1 59 40 15 —

M. time of new
moon, September } 23 3 38 18 52 30 P. M. 1st merid. A. D.
1793.

2dly, From 16d. 1h. 59', subtract 10h. 24', and
it will leave 15d. 15h. 35', to be subtracted for the
meridian of the Greenwich observatory. *E.g.*

D. H. ' " " "

From 39 5 37 59 7 30 P. M. new moon Oct.
1st merid. A. J. P. 706.

Subtract — 15 15 35 40 15 00

M. time of new
moon, Sept. } 23 14 2 18 52 30 At Greenwich, A. D. 1793

3dly, From 16d. 1h. subtract 10h. and it will
leave, in remainder, 15d. 15h. 59', to be subtracted
for the third given meridian. *E.g.*

D. H. ' " " "

From 39 5 37 59 7 30 P. M. new moon Oct.
1st merid. A. J. P. 706.

Subtract — 15 15 59 40 15 —

M. new moon, A. D. }
1793, September } 23 13 38 18 52 30 P. M. the 3d given
meridian.

The tabular time Sept. 23 13 39 — — — By Ferguson's Tables
of Full moons, cal-
culated to the nearest
minute.

Thus I have calculated the time of the radical new
moon, in September, A. D. 1793, in three distinct
meridians, as above.

But before we can exemplify the use of these calculated
times, we must again search out for such an astrono-
mical measure, as may be adequately commensurate
to

to the distance between the M. new moon in September, A. D. 1793, which is now the terminus à quo, and the M. new moon in October, A. J. P. 710, which is now the terminus ad quem. But such an astronomical and adequate measure may be just as easily found, as in the preceding example. *E. g.*

The interval is 5796 years, which, if considered as Julian years, will produce 2116989d. 0h. 0m.

If considered as tropical years, they will include 71687 lunations, which will give by reduction 2116958d. 9h. 18' 52" 15".

	D.	H.	'	"	'''
From the Julian reduction	2116989	00	00	00	00
Subtract the lunar, first throwing off 1 day	2116957	09	18	52	15
The astronomical measure sought		31	14	41	7 45

Application of the Astronomical Measure.

	D.	H.	'	"	'''	'''
To M. new moon, Sept. 23	3	38	18	52	30	1st merid. 1793
Add the astronomical measure	31	14	41	7	45	00
Octob. 24	18	19	26	37	30	
Reduce the hours to midnight +	1	12				
A. J. P. 710, new moon Oct.	25	6	19	26	37	30 A. M. 1st merid. Vid. p. 19.

2dly, To M. new moon, Sept. } 23 14 2 18 52 30 P. M. at Greenwich, 1793.

Add — 31 14 41 7 45 00

A. J. P. 710, M. new moon, October } 25 4 43 26 37 30 P. M. at Greenwich, Vid. p. 19.

3dly, To M. new moon, Sept. } 23 13 38 18 52 30 P. M. tabular merid. 1793.

Add — 31 14 41 7 45 00

A. J. P. 710, M. new moon, October } 25 4 19 26 37 30 Tabular merid. Vid. p. 19.

Every

Every intelligent reader will observe, and, I think, with some degree of admiration too, how the calculations *à posteriori* coincide with the calculations *à priori*, without the excess or defect of a single moment of time;—a perfection which your tables cannot attain to. Make the experiment.

Nor will any one, I imagine, resolve this coincidence into any other cause, but the mathematical exactness of tabular measures, and to principles as true as nature.

Having gone through all the particulars contained in the four points of enquiry, excepting only a confirmation of the times of the autumnal equinox in 3 given meridians, A. J. P. 710—but this will come in more properly under the articles of Letter IV. as I shall there have occasion to construct tables necessary for the purpose.

Now, permit me to ask you, whether it may not be thought well worth your while, as a professed Table-maker, to give some attention to proofs, “so mathematically true—as are out of all men’s power to give by any other tables extant.”——Witness,

JAMES FERGUSON,

Critical Review for May

1763, P. 330.

To Mr. James Ferguson.

LETTER IV.

IN my last letter, I shewed by calculations, first, à priori, and then à posteriori, what were the lunisolar characters, at the autumnal equinox, A. J. P. 710. the Rev. Dr. Blair's adopted æra of the creation; and that the distance of M. new moon, before that cardinal point, was 4h. 56' 33" 22''' 30''', to the precision of a moment, proving its identical quantity in 3 distinct meridians: a proof which lies out of the reach of all your discordant tables, none of them being sufficiently perfect to bring the sun and moon to the same meridian precisely: not one instance, I believe, can be given of it: and yet, you know very well, that this is an essential requisite in every calculation of a solar eclipse. Now let me see this bold imputation publickly refuted in a calm, cool, dispassionate manner, and with the true spirit of a philosopher. I take it for granted that you will not adopt my numbers.*

E

We

* I never have yet seen the third Edition of your Astronomy, so cannot speak from my own knowledge; but I have been told, that you have there adopted my length of the tropical year: I know that that number frequently occurs in books of astronomy, but always as a round number, never as the true length of the tropical year: and therefore, unless you can refer me to some tables constructed upon that measure, previous to the publication of my book of Chronology, I must, in justice to myself, publickly charge you with that species of literary theft, called Plagiarism.

This procedure of yours (if true) is the more extraordinary, as you have so sharply stigmatised me, (see Critical Review, for May 4. 1763) for daring to complain of my being unable to find the exact length

We will now go back from A. J. P. 710, to the A. J. P. 706, (the true historical æra of the creation, according to the joint computations of B. and K.) which lies 4 years higher up than that of Archbishop Usher's and Dr. Blair's. Here we are to calculate the autumnal-equinoctial full moon, in October, A. J. P. 706; first, by your tables of radical full moons, as I find them set down for the whole 18th century, in your *Treatise of Astronomy*, 2d edit. p. 218, 219, 220; and then by those of mine, constructed upon the characters of the original luni-solar radix; so that, by comparing the conclusions, we shall easily see, how far they agree, or disagree, with the scriptural astronomical data, so mathematically true.

And, surely, such calculations may be justly looked upon as no common trial of skill, between two zealous champions of very different casts; the one
openly

length of the tropical year, from the observations of the best astronomers. And now, at last, you have found it yourself, it seems, not from the observations of the best astronomers, but from the publications of a whiffing Chronologist. But how must this tarnish your credit, to have it said, that Mr. Ferguson, after several years practice, openly and publicly renounced the much-laboured determinations of his most eminent masters and teachers, upon the authority of one Kennedy, a Scripture-chronologist!

I beg to know whether the fact be true: if it is, I must immediately arraign you, not only for Plagiarism, but for Inconsistency too; for in your *Astronomical Pamphlet*, p. 5. you positively assert, that it appears from repeated observations, that the sun performs its annual revolution from the first point of Aries to the first point of Aries again, in 365d. 5h. 48' 55".

How are you tossed about with every wind of doctrine, which blows from one point of the compass to-day, and from another point to-morrow!

I know you to be extremely deficient, Mr. Ferguson, in the very first principles of practical astronomy: you suspect it not, because you have not yet been thoroughly searched into. And the reason why this is not generally known, and generally regarded, is, because but very few, perhaps not above 1 in 100,000, earnestly concern themselves about astronomy. I should not have employed half the time about it that I have, if I could not have made it subservient to the purposes of chronology; and, by its uncertainty, it has cost me infinite pains and labour.

openly professing himself an elliptical—the other, an equatorial and scriptural astronomer: the one ingenuously declaring, that he does not pretend to offer his tabular measures and calculations as quite perfect; nor does he flatter himself with the hopes of ever seeing them brought to a mathematical exactness: the other is quite sanguine in his persuasions, that his tabular measures, and the calculations founded upon them, are most accurately true.

Such a trial of skill, between two such combatants, who seem to be quite contrasts to each other, cannot fail, one would think, to excite a proportionable curiosity, in every qualified by-stander, and dispose him to wait for the issue with no small degree of impatience.

That we may have a clear view of what we have to do, I shall here give

A SCHEME,

Expressing the whole extent of the proposed operations.

A. J. P. 706.	Interval	A. J. P. 6506.
<u> </u>	5800	A. D. 1793.
⊙	years.	<u> </u>
		⊙

We have here 5800 Julian and tropical years, intervening between two distinct years of the Julian period, the last of which falls in with A. D. 1793. And as these 5800 tropical years are computed to begin and end at the autumnal equinox, we are to ascertain, by tabular calculations, the times of the autumnal-equinoctial full moon, in the end of the last, and in the beginning of the first year of the assumed interval.

Having fixed the boundaries of the proposed operations, from hence the combatants are to take their start, and a very extraordinary trial of skill commences.

It must be allowed, that in the present contest you have an apparent advantage over me ; for, whereas your radical numbers are near at hand, and will cost you very little more trouble than a bare inspection, mine must be sought for, with some sagacity of mind, in the most remote age of the world, far beyond the reach of all astronomical observations : and yet, if, when obtained, they do not appear, upon an examination of their results, to be in a natural and pretty close connection with the truth of yours, which were immediately derived from observation, you will, I presume, claim a right to reject them.

I now proceed to

The CALCULATIONS.

Required the M. full moon in September, 1793, by Ferguson's Tables of full moons, calculated to the nearest minute.

	D.	H.	M.
1793. To M. full moon, March	15	14	53
Add for 6 lunations to bring it to Sept.	177	4	24

By Table VI. full moon, September 8, 192 19 17 tabular merid.

Required M. full moon, in October, A. J. P. 706, in the same meridian.

	D.	H.	M.
To M. full moon, September	8	19	17
Add for 2 lunations — —	59	1	28
Subtract the 30 days of September	67	20	45
From the remainder — —	37	20	45
Subtract for 5800 years — —	15	12	40
M. Full moon, October — —	22	8	5 p.m. A.J.P. 706.
	tabular merid,		

I call these Mr. Ferguson's calculations, because they were made by the directions of his Tables, unless he can

can make it appear, that I have either mistaken his tabular numbers, or misapplied them.

I shall leave it to Mr. Ferguson himself, to compare his tabular time of the autumnal equinoctial full moon, A. J. P. 706, (namely, October 22d. 8h. 5m. P. M.) with the original luni-solar characters, or time of the original full moon, so plainly expressed, Tab. II. p. 15. and publickly to announce a mathematical coincidence.

He may take his choice, either to estimate the error of this his calculated M. time of full moon, or to vindicate its truth; one of them may be reasonably expected.

It is now my turn, as an engaged co-operator, to calculate the times of the same autumnal-equinoctial full moons, namely, that in September, 1793, and also that in October, A. J. P. 706. But I am retarded in my course, being again under the necessity to provide myself with tables of radical numbers; there being none that I know of framed ready to my hands, that can be of the least service to me; and however difficult the research may be, I must stand still till I can find.

Looking again into Table II. p. 15. (the sure and faithful repository of fundamental and practical principles of astronomy) I find a full moon on the 24th of October, oh. om. I immediately form these characters into a table for 4 years; which may be readily done, by only adding 6 to the hours successively; and then it may be entitled,

A TABLE of RADICAL NUMBERS,

For the more easy and accurate calculation of M. Autumnal-Equinoctial Full Moons, in any given Meridian, and in any given Year, either before or after the vulgar Christian Era, without any limitation of time.

		D. H. M.	
A. J. P. 706. after Biss.	1 Oct.	24 00 00	full moon, 1st meridian.
	2	24 6 00	
	3	24 12 00	
	0	23 18 00	

As the present operations confine me to the proof of the given characters of the original luni-solar radix, by a calculated coincidence as mathematically true, as the given characters themselves are; I shall not spend time in explaining the several useful properties of the annexed table, but shall only subjoin a short one, including the astronomical principles, from which it was immediately derived, and upon which it was constructed.

A TABLE of RADICAL NUMBERS,

For the more easy and accurate calculation of Equinoxes and Solstices, in any given Meridian, and in any given Year, either before or after the vulgar Christian Era, without any limitation of time.

		Vernal Equinox	Summer Solstice.	Autumnal Equinox.	Winter Solstice.
		Month April	Month July.	Month October.	Month January.
		D. H. M.	D. H. M.	D. H. M.	D. H. M.
After Bissex.	1	21 11 58	23 10 40	25 00 00	22 15 57
	2	21 17 58	23 16 40	25 6 00	22 21 57
	3	21 23 58	23 22 40	25 12 00	23 3 57
	0	21 5 58	23 4 40	24 18 00	22 9 57

A TABLE of the TIMES of the SUN's Entry

Into the 4 Cardinal Points of the Ecliptic, beginning at the Winter Solstice, A. D. 1752, and ending at the Winter Solstice, A. D. 1753, as they were observed by the late Reverend Dr. Bradley, in the Meridian of the Greenwich observatory.

Vernal Equinox.	Summer Solstice.	Autumnal Equinox.	Winter Solstice.	A. D. P. M. 1752 1753
Month March.	Month June.	Month Septem.	Month Decem.	
D. H. M.	D. H. M.	D. H. M.	D. H. M.	
Bisext.				
Aft. Biss. 19 22 33	20 21 15	22 10 24	21 2 21	

Before these tables can be practically applied, I must find out such an astronomical number, as may precisely measure the distance between the two autumnal equinoxes, in the two given years of the Julian period, namely, 706 and 6506, interval 5800 years. But first,

We have here a proper opportunity to prove, by calculations à posteriori, (as I hinted before, p. 16.) the times of the autumnal equinox, calculated à priori, in 3 given meridians, A. J. P. 710. See the Table, p. 17.

In order to perform this engagement, we must first calculate the times of the autumnal equinox, A. D. 1793, interval 5800 years.

5800 Julian years being multiplied into 11', produce 44d. 7h. 20m. which is the astronomical measure for that interval.

A. D. 1793, will be the first after Bisextile, and therefore the radical numbers are Oct. 25d. 00h. 00m. Add, to make the subtraction, the 30 days of September, and the sum will be 55d. 00h. 00m.

D. H. M.

From 55 00 00 ☉ in ♈, first meridian, A. J. P. 706,
 Subtract 44 7 20

Septem. 10 16 40 P. M. ☉ in ♈, 1st merid. A. D. 1793.

2dly, From 44d. 7h. 20m. subtract 10h. 24m. for the difference of longitude in time between the first meridian, and the meridian of the Greenwich observatory; it will leave, in remainder, 43d. 20h. 56m. to be subtracted.

D. H. M.

From 55 00 00 ☉ in ♈, first meridian, A. J. P. 706.
 Subtract 43 20 56

Septem. 11 3 4 P. M. ☉ in ♈, at Greenwich, A.D. 1793.

The PROOF.

A.D. 1753, the sun was observed to enter Libra O.S. September 11d. 10h. 24m. P.M. (see the short Table, p. 31. under ☉ in ♈) the interval is 40 years, which being multiplied into 11', will give 7h. 20m. for the retrocessions of the equinox.

D. H. M.

From Sept. 11 10 24 P. M. the observed time of ☉ in ♈,
 Greenwich, 1753,

Subtract 00 7 20

We shall have Sept. 11 3 4 P. M. the calculated time at Greenwich, A. D. 1793, which was to be proved.

3dly, From 44d. 7h. 20m. subtract 10h. 1m. for the difference of longitude in time between the first meridian and Ferguson's tabular meridian, for M. full moons calculated to the nearest minute, and it will leave, in remainder, 43d. 21h. 19m. to be subtracted.

D. H. M.

From 55 00 00 ☉ in ♈, first meridian, A. J. P. 706.
Subtract 43 21 19

September 11 2 41 P. M. ☉ in ♈, tabular merid. A. D. 1793.

We say then, that A. D. 1793, the sun will come to the autumnal equinox,

D. H. M.

1st, September 10 16 40 P. M. first meridian, A. D. 1793.
2dly, 11 3 4 P. M. at Greenwich, A. D. 1793.
3dly, 11 2 41 P. M. in the tabular merid. A. D. 1793.

Now let it be required to find, by a calculation backwards through a series of 5796 years, the Julian M. D. H. and M. on which the sun came to the autumnal equinox, in the 3 given meridians, A. J. P. 710.

5796 Julian years being multiplied into 11', will produce 44d. 6h. 36m. for the astronomical measure. Therefore,

D. H. M.

1st, To September 10 16 40 P. M. ☉ in ♈, first meridian, A. D. 1793.

Add ——— 44 6 36

October 24 23 16

Reduce the hours to midnight + 1-12 00

October 25 11 16 A. M. ☉ in ♈, first merid. A. J. P. 710.
p. 17.

D. H. M.

2dly, To September 11 3 4 P. M. ☉ in ♈, at Greenwich, A. D. 1793.

Add ——— 44 6 36

October 25 9 40 P. M. ☉ in ♈, at Greenwich, A. J. P. 710, p. 17.

D. H. M.

sdly, To September 11 2 41 P. M. ☉ in ♈, tabular mer-
ridian, 1793.

Add ——— 44 6 36

October 25 9 16 + 1' ☉ in ♈, tabular me-
ridian + 1', A. J. P.
710, p. 17.

Now compare these calculated times with those in the table, p. 17. and you will find the difference to be only 1', and that in the tabular meridian.

But as a confirmation of the times of the autumnal equinox, calculated à priori, in 3 distinct meridians, in a given year of the Julian period, by a calculation backwards through a long series of years, may be thought somewhat distinguishing, I shall make the subsequent calculations in a quite different method, which may justly render them more distinguishing still.

A. D. 1753, the sun was observed to enter Libra, in the meridian of the Greenwich observatory O. S. September 11d. 10h. 24m. P. M. subtract these 10h. 24m. and it will carry it back to September 11d. 00h. 00m. for the time of the equinox, in the first meridian, which it may be more convenient to express in this form, September 11d. 12h. 00m. after midnight.

I will here give a table for the time of the equinox in 3 meridians, A. D. 1753.

D. H. M.

1st, Sept. 11 12 00 after M. N. ☉ in ♈, first meridian,
A. D. 1753.

2dly, Sept. 11 10 24 P. M. ☉ in ♈, Greenwich.

3dly, Sept. 11 10 1 P. M. ☉ in ♈, tabular meridian.

These numbers 10h. 24m. and 10h. 1m. intuitively express the difference of longitude in time computed from the first meridian eastward.

Now let it be required, to calculate the Julian M. D. H. and M. of the autumnal equinox, in the 3 given meridians, A. J. P. 710, interval 5756 years.

1st, From

D. H. M.

1st, From Sept. 11 12 00 after M. N. ☉ in ♉, first meridian,
A. D. 1753.

Sub tract 00 00 44

September 11 11 16

Add 44 00 00

October 25 11 16 A. M. ☉ in ♉, 1st meridian, A. J. P.
710, P. 17.

D. H. M.

2dly, From Sept. 11 10 24 P. M. ☉ in ♉, at Greenwich,
A. D. 1753.

Subtract 00 00 44

September 11 9 40 P. M.

Add 44 00 00

October 25 9 40 P. M. ☉ in ♉, at Greenwich, A. J. P.
710, p. 17.

D. H. M.

3dly, From Sept. 11 10 1 ☉ in ♉, tab. merid. A. D. 1753.

Subtract 00 00 44

September 11 9 16 + 1'

Add 44 00 00

October 25 9 16 + 1' ☉ in ♉, tab. merid. + 1',
A. J. P. 710.*

F 2

Having

* These last calculations may merit your best attention; for may not you, and others besides you, be induced to ask, Upon what principles does this man calculate the moment of the sun's entry into the first point of Libra, in 3 meridians (excepting only an error of 1' in the tabular meridian, which it is not worth the while to account for) through a series of 5756 years, by only subtracting 44' from the times of the autumnal equinox, in a given year, namely, A. D. 1753, and one of them too is the observed time?

Believe me, old friend, it behoves you to exert the utmost of your skill, to estimate the error of my equatorial times of the autumnal equinox, A. J. P. 710; for should they, peradventure, baffle your estimate by the exactness of their truth, the consequence will be, that your solar equations, in the calculations of an equinox

Having made good the hint I gave you, concerning the necessity of supporting the calculations *à priori*, by calculations *à posteriori*; (and I hope I have done it to your full satisfaction.)

In the next place, let it be required, to calculate the Julian M. D. H. and M. on which the sun came to the autumnal equinox, in the 3 given meridians, A. J. P. 706, A. M. o.

The subjoined table of the times will be exactly the same to a minute, as they were A. D. 1753, excepting only the corresponding day of the Julian month.

This identity of the times I shall not ask the Elliptical Astronomer to explain.

The TABLE.

D. H. M.

Oct. 25 00 00 ☉ in ♈, 1st merid. A. J. P. 706, A. M. o.
 25 10 24 P. M. ☉ in ♈, Greenwich, A. J. P. 706, A. M. o.
 25 10 1 P. M. ☉ in ♈, tab. merid. A. J. P. 706, A. M. o.

Proved by a calculation backwards through a series of 5800 years.

D. H. M.

To Sept. 10 16 40 P. M. ☉ in ♈, 1st merid. A. D. 1793.
 Add 44 7 20

October 25 00 00 ☉ in ♈, 1st merid. A. J. P. 706, A. M. o.
 2dly,

nox or a solstice, must henceforth be deemed not only unastronomical, but even unnatural and absurd.

If you have really adopted 365d. 5h. 49m. for the true length of the tropical year, (as I hope you have) you have, *ipso facto*, given up your elliptical astronomy; I do not mean in theory, (for your theories of elliptical motion will, I believe, ever stand firm and unshaken) but I mean in *practical application* only. And it would be now full as absurd for you to plead for the necessity of solar equations in the calculations of an equinox or a solstice, as for the equality of twice two to fifteen in numbers.

This signal advantage you have gained, at last, by rolling from one tabular measure to another, not knowing, for several years together, where to settle.

D. H. M.
 2dly, To Sept. 11 3 4 P. M. ☉ in ♈, Greenwich, A. D. 1793.
 Add 44 7 20

October 25 10 24 P. M. ☉ in ♈, Greenwich, A. J. P. 706,
 A. M. o.

D. H. M.
 3dly, To Sept. 11 2 41 P. M. ☉ in ♈, tab. merid. A. D. 1793.
 Add 44 7 20

October 25 10 1 P. M. ☉ in ♈, tabular meridian, A. J. P.
 706, A. M. o.

Compare these calculated times with the tables above, and note their difference.

But as the original characters are luni-solar, we must now proceed to the

LUNAR COMPUTATION.

Required the astronomical measure of the distance between two given full moons, the interval 5800 years.

5800 Julian years produce 2118450d. 00h. 00m.

5800 tropical years include 71736 lunations, the last of which will terminate on that full moon which will happen next before the autumnal equinox, A. D. 1793.

71736 lunations produce 2118405d. 9h. 16' 18".

	D. H. ' "
From the Julian reduction 2118450 00 00 00	
Subtract the lunar, having first thrown off 1 day 2118404 9 16 18	
The remaind. is the astronomical measure sought	45 14 43 42

The PRACTICAL APPLICATION.

A. D. 1793 will be the first after Bissextile; therefore the radical numbers are (see the Table, p. 30.)
 October 24d. 00h. 00m. full moon, first meridian,
 A. J. P. 706, A. M. o. Add, to make the subtraction

tion, the 30 days of September, and the sum will be 54d. 00h. 00m.

Now, let it be required, to calculate the Julian M. D. H. and M. of M. full moon in the 3 given meridians next before the autumnal equinox, A. D. 1793.

D. H. ' "

From 54 00 00 00 full moon, 1st merid. A. J. P. 706. A. M. 0.
Subtract 45 14 43 42

Sept. 8 9 16 18 p. m. M. full moon, first merid. A. D. 1793.

2dly, From 45d. 14h. 43' 42" subtract 10h. 24m. and it will leave, in remainder, 45d. 4h. 19' 42" to be subtracted for the meridian of Greenwich.

D. H. ' "

From 54 00 00 00 full moon, first merid. A. J. P. 706. A. M. 0.
Subtract 45 4 19 42

Sept. 8 19 40 18 p. m. M. F. M. at Greenwich, A. D. 1793.

3dly, From 45d. 14h. 43' 42" subtract 10h. 1m. and it will leave, in remainder, 45d. 4h. 42' 42" to be subtracted for the tabular meridian.

D. H. ' "

From 54 00 00 00 full moon, 1st merid. A. J. P. 706. A. M. 0.
Subtract 45 4 42 42

September 8 19 17 18 P. M. full moon, tab. merid. A. D. 1793.
Tab. Time 8 19 17 00

We say then, that A. D. 1793, the M. time of that full moon, which will happen next before the autumnal equinox, A. D. 1793, will be, in the 3 given meridians, as follows.

1st,	September 8 9 16 18 P. M. first meridian.
2dly,	8 19 40 18 P. M. at Greenwich.
3dly,	8 19 17 00 tabular meridian.

Required

Required the astronomical full moon epact, at the autumnal equinox, A. D. 1793.

The CALCULATION.

	D.	H.	'	"
From the solar tropical reduct. of 5800 years,	2118405	16	40	00
Subtract the lunar, having first thrown off 2 days	2118403	9	16	18
The full moon astronomical epact	2	7	23	42

The PROOF.

	D.	H.	'	"
1 st , From Sept. 10 16 40 00 P.M. ☉ in ♈ 1 st merid.				
				A. D. 1793.
Subtract 8 9 16 18 full moon, 1 st merid.				
				A. D. 1793.
The full moon epact, as before	2	7	23	42

	D.	H.	'	"
2 ^{dly} , From Sept. 11 3 4 00 P.M. ☉ in ♈ at Greenwich, A. D. 1793.				
Subtract 8 19 40 18 P.M. full moon at Greenwich, A. D.				
				1793.
The full moon epact, as before	2	7	23	42

	D.	H.	'	"
3 ^{dly} , From Sept. 11 2 41 00 ☉ in ♈, tab. merid.				
				A. D. 1793.
Subtract 8 19 17 18 full moon, tab. merid.				
				A. D. 1793.
The full moon epact, as before	2	7	23	42

Now all this variety of calculations serves only to prepare the way for the more effectually accomplishing the principal point in view; and that is, to ascertain the given moment of the original full moon (the given moment of the original autumnal equinox having been ascertained already in the 2 given meridians) by calculations as mathematically true, as the original characters themselves are; which
precision

precision can only be manifested by a mathematical coincidence.

Required, the astronomical measure of the distance between that M. full moon, which will happen next *after* the autumnal equinox, A. D. 1793, and that full moon which happened next *before* the autumnal equinox, A. J. P. 706. A. M. o. Interval 71737 lunations.

I will here give a table of the times of that full moon which happened next before the autumnal equinox, A. J. P. 706, in 3 meridians, as I did above, of the times of the autumnal equinox in the same year, and in the same meridians; that we may the more easily see how far the calculated times either agree or disagree with them.

The TABLE.

	D. H. M.	
1st, Oct.	24 00 00	full moon, 1st merid. A. J. P. 706. A. M. o.
2dly,	24 10 24	P. M. full moon, at Greenwich, A. J. P. 706, A. M. o.
3dly,	24 10 1	P. M. full moon, tab. merid. A. J. P. 706, A. M. o.

We have here the same identity of the times of full moon, in the same meridians, as we had of the autumnal equinox (p. 34.) A. D. 1753.

I could wish that some physiological astronomer would favour me so far, as to lay open and explain the true astronomical grounds and reasons of this identity of the times, both of full moon, and of the autumnal equinox, in the same meridians, at the distance of more than 5700 years.

I could wish, I say, for such a favour; but I dare not presume to ask it,

Here follow

The CALCULATIONS.

	D.	H.	'	"	'''
From the sum of 2 lunations	59	1	28	3	30
Sub. the astronomical measure calculated above	45	14	43	42	00
The remainder	13	10	44	21	30

	D.	H.	'	"	'''
From 29 12 44 1 45 the length of a mean lunation,	29	12	44	1	45
Subtract the remainder	13	10	44	21	30
The astron. measure sought	16	1	59	40	15

The PRACTICAL APPLICATION.

	D.	H.	'	"	'''
To Sept. 8 9 16 18 00 p. m. M. full-moon, 1st merid. A. D. 1793, p. 38. next before ☉ in ♌.	8	9	16	18	00

Add for 1 lunation 29 12 44 1 45

1st, To October 7 22 00 19 45 p. m. M. full-moon next after ☉ in ♌, 1st merid. A. D. 1793.

Add the astronomical measure } 16 1 59 40 15

October 24 00 00 00 00 full moon, 1st meridian, A. J. P. 706, A. M. o.

2dly, To Sept. 8 19 40 18 00 p. m. M. full-moon at Greenwich, A. D. 1793, p. 38. next before ☉ in ♌.

Add 29 12 44 1 45

October 8 8 24 19 45 p. m. M. full moon at Greenwich, next after ☉ in ♌, A. D. 1793.

Add 16 1 59 40 15

October 24 10 24 00 00 P. M. full moon at Greenwich, A. J. P. 706, A. M. o.

G

3dly, To

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D. H. ' " "

3dly, To Sept. 8 19 17 18 00 p. m. M. full moon tabular
merid. A. D. 1793, p. 38.
before ☉ in $\sphericalangle$.

Add 29 12 44 1 45

October 8 8 1 19 45 p. m. M. full moon tabular
merid. A. D. 1793, next
after ☉ in $\sphericalangle$.

Add 16 1 59 40 15

October 24 10 1 00 00 p. m. M. full moon tabular
meridian, A. J. P. 706,
A. M. o.

Should it be objected, that these calculated coincidencies are not so mathematically true as the original luni-solar characters themselves are; they who make the objection, must be left to their own opinion, without any opposition from me.

Required the original full-moon epact, or the precise distance of the original full moon, before the original autumnal equinox.

The First Calculation.

4 tropical years give 1460 entire days.

In 4 tropical years there are 49 lunations and a half; these produce 1461 entire days.

From 1461 entire days, in the lunar computation,
Subtract 1460 entire days, in the tropical solar.

Remains, the original }
full-moon epact, 1

The Second Calculation.

It appears by a preceding calculation, that the quadriennial decrease of the epact is, 19h. 3' 26" 37" 30'''; and that the new-moon epact, at the autumnal equinox, A. J. P. 710, was 4h. 56' 33" 22" 30'''.

To

	H.	I	"	'''	'''
To the quadriennial decrease of the epact	19	3	26	37	30
Add the quantity of the new-moon epact	4	56	33	22	30

The sum is the original full-moon epact, 1d. = 1024 00 00 00 00

The Third Calculation.

5800 Julian years produce 2118450d. 00h. 00m.
 5800 tropical years include 71737 lunations, the last of which will terminate at that full moon, which will happen next after the autumnal equinox, A. D. 1793.

71737 lunat. produce 2118405d. 22h. 00' 19" 45''', from which throw off 2 days, by the direction of astronomical principles (explained in my Appendix to VII. Letters, addressed to the Reverend Dr. Blair, prebendary of Westminster) and there will remain 2118443d. 22h. 00' 19" 45'''; to these add the last calculated astronomical measure, namely, 16d. 1h. 59' 40" 15'', and the sum will be 2118449d. 00h. 00m.

	D.	H.	M.
From the Julian reduction	2118450	00	00
Subtract the reduction of 71737 lunations	2118449	00	00
Remains the original full-moon epact	1		

A right understanding, and a thorough knowledge of the principles and measures by which these last calculations were made, may be well thought a full recompence for all the time they may cost, if accurate tabular numbers are of any importance. Try to ascertain the original full-moon epact, by a calculation backwards through an uninterrupted series of 71737 lunations, by your tabular numbers; by such a trial you will soon become sensible, both of the want and the value of mathematical precision.

The foregoing calculations of the original Full-moon Epact proved by its identical quantity in 3 distinct meridians.

D. H. M.

1st, From Oct. 25 00 00 $\odot$ in Δ , 1st merid. A. J. P. 706, A. M. 0.

Subtract 24 00 00 Full moon, 1st merid. See Tab. II. p. 15.

The original }
F. moon epact } 1

D. H. M.

2dly, From Oct. 25 10 24 P. M. $\odot$ in Δ , Greenwich, A. J. P. 706, A. M. 0.

Subtract 24 10 24 P. M. full moon at Greenwich, A. J. P. 706, A. M. 0.

The original }
F. moon epact } 1 0 0

D. H. M.

3dly, From Oct. 25 10 1 P. M. $\odot$ in Δ , tab. merid. A. J. P. 706, A. M. 0.

Subtract 24 10 1 P. M. full moon, tab. meridian, A. J. P. 706, A. M. 0.

The orig. }
F. M. epact } 1

The CONCLUSION.

And now, Mr. Ferguson, as you are a co-operator in this amicable trial of skill, it might justly be demanded of you, and reasonably expected from you, that you should calculate this whole variety of particulars—in your own way.

But as it is natural for every disputant to wish at least, that he might be so far able to overpower his opponent, as to silence him, I will exert my endeavours, not only to dissuade, but even to discourage you from such a rash and desperate undertaking.

Be pleased then to know from me, what, as far as I am able to judge from all your tabular calculations which I have examined, you seem not to know as yet, or, at least, not to have duly considered,

1st, That

1st, That the excess or defect of $1''$, in the tabular measure of a mean lunation, if multiplied into 71737, will cause a prodigious error in the mean time of a new or full moon, in the remote age of the world, of no less than

19h. 55' 37"

2^{dly}, The excess or defect of $1'''$, which is an insensible particle of time, if multiplied into the same number, will cause an error of

19' 55" 37'''

3^{dly}, The excess or defect of $1''''$, which is a more insensible particle of time still, if multiplied as before, will cause an error of

19" 55''' 37''''

Here therefore I must remind you of what was remarked above, Letter I. p. 1 " That the
" tabular measures which are to regulate and
" direct such extraordinary calculations, must
" be as mathematically true, as the original
" luni-solar characters themselves are: i. e.
" they must be without the excess or defect of
" a single moment of time, as if they were immediately derived from the heavens themselves."

Things being thus circumstantiated, by a rigorous and inflexible law, it must be left to your own judgment, whether it may not be more prudent on your part to decline, than resolutely to undertake, the whole variety of the proposed operations: if you succeed, it will indeed be a miracle: if you fail but in one single article, then you must publicly acknowledge the superior accuracy and skill of the *Æquatorial* and *Scriptural*, above the *Elliptical*, Astronomer.

Dictum sapienti sat est.

J. K.

A N

A P P E N D I X

T O T H E

FOREGOING LETTERS,

Containing a Review of Mr. FERGUSON'S
Remarks upon the Astronomical Part of
my System of Chronology.

See the Critical Review for May, June, and November, 1763.

Old Friend,

AS you was pleased to assure me in your last, that you was fully purposed to republish your favourite epistle (in an angry mood, I suppose, by way of reprisal for my Preface to the VII. Letters addressed to Dr. Blair, which you did not choose to examine and reply to) I began to think it high time for me to take some cognizance of all you have published against the astronomical part of my system; and try, at least, if I could not vindicate every article, which you, with such a visible want both of temper and judgement, and with such an ambitious zeal, have attacked.

Having found those papers, which I told you I had mislaid, and really thought for some time that they were lost; I sat down with a full intent to read them through with candour and attention, but found them so abounding with peevish, pettish, splenetic expressions

sions—with unbecoming apostrophes—with conceited exclamations, instead of arguings—in short, with such flagrant instances and proofs of a most profound ignorance, that it was with no small difficulty that I waded through the motley farrago.

However, having at last got through the disagreeable and irksome struggle, and recollecting particulars, I fixed my attention upon a challenging paragraph, which I shall here cite.

Critical Review for June, p. 413. signed, James Ferguson.

“ Now, if Mr. Kennedy can shew, by calculating
 “ downward from the time of his original full moon,
 “ through an uninterrupted series of lunations, that
 “ this eclipse (namely, Mesors 16. H. 7. P. M. An.
 “ ær. Nabonass. 547) might have happened at the
 “ time recorded by Ptolemy, I shall believe that his
 “ original radix, and his length of a mean lunation,
 “ are just.

——“ And surely, he will not dispute the autho-
 “ rity of Ptolemy in this case, after having laid such
 “ stress upon Ptolemy’s canon, as he has done.”

——“ And Mr. Kennedy’s general method is to
 “ to calculate downward from his original
 “ radix.

——“ But he will find it impossible by his Tables,
 “ that this eclipse could be visible at Alex-
 “ andria.”

Was I requested by an authority, which I was neither willing nor able to disobey, to publish a full and complete answer to all Mr. Ferguson’s remarks upon the astronomical part of my System, so far as it has an immediate concern with astronomy—to every studied objection—to every affected cavil—to every rude and impertinent sneer—to every sarcastical reflection upon the authority to which I appeal—to every smart stroke upon my want of skill in astronomy—to every

every childish repetition of—I said, and you said—I would not desire any other medium, than those few lines cited above, whereby to refute and dissipate them all.

I am challenged to make a calculation, which my prejudging critic pronounces impossible: upon a presumption of its impossibility, he engages his word, to believe somewhat, which it is plain, that at the time of this voluntary engagement, he did not believe at all.

He engages his word, for I must repeat it, that such a calculation cannot fail to convince him, that my original radix must be somewhat more than a—wind-mill in my head—for so my sagacious and penetrating examiner, with mother-wit, sense and judgement, has defined it. And moreover, that my length of a mean lunation must have much more of intrinsic value in it, than merely to be reckoned amongst the instances of my—childish thoughtlessness—for so my discerning and courtly critic, with an elegance equal to his gentility, has emblazoned me. Indeed, a pretty large nose-gay of such sweet-scented flowers of rhetoric might be collected from the 37 pages of his much-laboured performance.

But here I must whisper a word or two softly in my self-confident critic's ear, and tell him, with all the tenderness I can, that his voluntary stipulation to believe, that my original radix, and my length of a mean lunation, are just, are by no means adequate terms and conditions; because it runs strongly in my head, that ere long, he will find himself under a necessity, both as a professed Astronomer, and as our Table-maker in chief, publickly to acknowledge the originality of the one, and to adopt the precision of the other.

But let the issue of the subsequent calculations bear their irrefragable testimony to the grounds and reasons of my confidence.

I shall now enter upon

The CALCULATIONS,

Which I shall make, first in the Egyptian, and then in the Julian style, to cut off all plea from your not having a pattern to copy after.

Ptolemy, in recording the times of the eclipse now under consideration, has computed such an Egyptian month, and day of the month, as plainly indicate that it must have been observed at that full moon, which came next before the autumnal equinox in the given year.

I shall therefore, by way of introduction, give a synopsis of such data, as form the basis of the ensuing calculations.

An eclipse of the moon was visible at Alexandria, towards the latter end of the fourth year of the reign of Ptolemy Epiphanes, king of Egypt—at that full moon which came next before the autumnal equinox, in that year—middle time at Alexandria, H. 7. P. M. Almeg. l. 4 c. 11.

From these data, several articles of enquiry will arise, which will demand a satisfactory answer.

ARTICLES of ENQUIRY.

I. In what solar tropical year of the world? II. In what year from Nabonassar? III. In what Calippic period, and in what year of that period? IV. In what Olympiad, and in what year of that Olympiad, was this eclipse observed at Alexandria? V. In what Egyptian month, on what day of the month, at what hour and minute, did the sun come to the autumnal equinox, on the meridian of Alexandria, in that year? VI. On what day of the week? VII. In what Egyptian month, on what day of the month, at what hour and minute, did the mean time of that eclipsed

H

full

full moon happen, on the meridian of Alexandria? VIII. On what day of the week? IX. At what precise distance before the autumnal equinox, did the M. full moon happen? The answer to this query will determine the sun's place in the ecliptic, at the time of this eclipse. X. What was the difference between the mean time of this eclipsed full moon, and the recorded middle time? XI. Whether the numbers, which in the tables of equations should answer to it, must be sought for within or without the limits of nature? XII. Whether this difference be additive or ablative?

All these articles of enquiry we must both of us go through, and, with the utmost exertion of our skill, give, if it may be, satisfactory answers to them. I say, Both of us; for why should Mr Ferguson plead for, or desire an exemption? He is a professed Astronomer, and has his own Tables, both solar and lunar; let him therefore be up, and doing.

The First ARTICLE of ENQUIRY.

In what solar tropical year of the world did this eclipse happen?

If we look into my Chronological Table, p. 48. for Ptolemy Epiphanes, we shall find the third year of his reign in the same parallel line with A. M. 3807.

But here I must observe, that by the construction of this table, as the years of the world are uniformly computed to begin and end at the autumnal equinox, so the years of the reigns of the kings in Ptolemy's canon, are as uniformly computed, rejecting Ptolemy's Thoth, to begin and end at the vernal equinox: hence it is, that the fourth year of Ptolemy Epiphanes begins at the vernal equinox, A. M. 3807, and ends at the vernal equinox, A. M. 3808. And as this eclipse happened at that full moon which came next before the autumnal equinox, it is certain, that if respect be had to Ptolemy's Thoth, it must have been observed towards the latter end of the fourth year of Ptolemy Epi-

phanes, and likewise towards the end of A. M. 3007.

Thus the first article of enquiry is satisfied.

The Second ARTICLE of ENQUIRY.

In what year from Nabonassar did this eclipse happen?

According to my Chronological Table, p. 37. the æra of Nabonassar commenced, A. M. 3261, upon some intermediate day between the winter solstice, and the vernal equinox.

From A. M. 3261 subtract 1, and it will carry it back to A. M. 3260, which immediately preceded the beginning of this æra. From A. M. 3007 subtract A. M. 3260, and the remainder 547 will be the year from Nabonassar assigned by Ptolemy. And what would you more?

Thus the second article of enquiry is satisfied.

The Third ARTICLE of ENQUIRY.

In what Calippic period, and in what year of that period, did this eclipse happen?

The Calippic period commenced in the fourth year of Darius Codomannus, at the summer solstice, together with the 3d year of the 112th Olympiad.

If we look into my Chronological Table, p. 47. for the fourth year of Darius III. called Codomannus, we shall find it in the same parallel line with A. M. 3677, from which subtract A. M. 3260, and the remainder, 417, will be the concurrent year from Nabonassar.

The Calippic period is compounded of 4 Metonic cycles, each consisting of 19 years; and it is a system of 76 years.

From A. M. 3807 subtract A. M. 3677, and it will give an interval of 130 years; from 130 subtract, for 1 Calippic period, 76; and the remainder will shew

that this eclipse was observed at Alexandria, in the 54th year of the second period of Calippus. So says Ptolemy. And what would you more?

If to an. ær. Nabonaf. 417, we add the calculated interval 130, the sum 547 will be again the year from Nabonassar, recorded by Ptolemy.

Thus the third article of enquiry is satisfied.

The Fourth ARTICLE of ENQUIRY.

In what Olympiad, and in what year of that Olympiad, was this eclipse observed at Alexandria?

According to my Chronological Table, p. 37. the æra of the Olympiads commenced at the summer solstice, A.M. 3232. From A.M. 3807 subtract A.M. 3231, and it will leave a series of 576 expanded years, which being divided by 4, will give in the quotient 144 complete Olympiads; but as this eclipse happened after the summer solstice, an. ær. Nabonaf. 547, we may set it down thus, Olympiad CXLV.

Thus the fourth article of enquiry is satisfied.

The Fifth ARTICLE of ENQUIRY.

In what Egyptian month, on what day of the month, at what hour and minute, did the sun come to the autumnal equinox, on the meridian of Alexandria, an. ær. Nabonaf. 547, A.M. 3807?

Before we can make good the contents of this article, it will be previously necessary to give

A T A B L E

Of the times of the Sun's entry into the four Cardinal Points of the Ecliptic, on the Months and Days of the Egyptian Year, for the four first Years of the Reign of Nabonassar, calculated for the meridian of Alexandria, to which, if we add 50', it will give the time at Babylon, as computed by Ptolemy.

The years of a Qua- driennium	The Solar Tropical years of the world.	☉ in ♈ Month Thoth.	☉ in ♉ Month Tybi.	☉ in ♊ Month Pharmuthi	☉ in ♋ Month Epiphi.	
		D. H. M.	D. H. M.	D. H. M.	D. H. M.	
0	3260	— — —	— — —	— — —	5 6 42	P.M.
1	3261	29 8 43	2 7 25	5 20 37	5 12 31	
2	3262	29 14 32	2 13 14	6 2 23	5 18 20	
3	3263	29 20 21	2 19 3	6 8 12	6 0 9	
0	3264	30 2 10	3 0 52	6 14 1	6 5 58	

By the help of this table, the days of the Egyptian month, on which the sun entered any of the four cardinal points, and on which the new moons and full moons happened, either next before, or next after, an equinox or a solstice, may be easily calculated (by the help of the epact, as we shall see by and by) in any given year from Nabonassar.

The CALCULATION.

Divide A.M. 3807 by 4, and the remainder 3 will shew, that it was the 3d year of a quadriennium, and so was A.M. 3263. In the same parallel line, under ☉ in ♊, we find these times, Pharmuthi 6d. 8h. 12m. P.M.

Required the hour and minute of the autumnal equinox, at Alexandria, an. ær. Nabonaf. 547, A.M. 3807.

The CALCULATION.

From A.M. 3807 subtract A.M. 3263, and it will leave an interval of 544 years.

544 Julian years being multiplied into 11', will shew, by the product, that A. M. 3807, the sun came to the autumnal equinox, 4d. 3h. 44m. earlier than it did A. M. 3263, an ær. Nabonass. 3.

From Pharmuthi 6d. 8h. 12m. subtract, for the retrocessions of the equinox, in 544 years, 4d. 3h. 44m. and we shall have Pharmuthi 2d. 4h. 28m. P. M. for the time of the equinox, at Alexandria, in the given year.

Required the Egyptian month, and day of the month, answering to the day of the autumnal equinox, in the given year.

The CALCULATION.

Divide 547 by 3, and the quotient will give 136 days for the retrocessions of Thoth in that time.

To Pharmuthi 2, add 136, and the sum will be 138d. Pharmuthi is the 8th month of the Egyptian year; in 7 equal months there are 210d. which being added to 138 will make 348 days; in 11 equal months there are 330 days, which being subtracted from 348, will leave Mefori 18d. 4h. 28m. P. M. for the Egyptian month, day, hour, and minute of the autumnal equinox, at Alexandria, An. 547, A. M. 3807.

Thus the fifth article of enquiry is satisfied.

The Sixth ARTICLE of ENQUIRY.

On what day of the week did the sun come to the autumnal equinox in the given year?

The CALCULATION.

3807 tropical years produce 1390477d. 16h. 03m. Add, to bring the time to Alexandria, 12h. 25m. and we shall have 1390478d. 4h. 28m. P. M. ☉ in = at Alexandria. Add, from Table II. p. 8. the numeral character 4, then we shall have 1390482d.

Divide

Divide by 7)1390482(198640 complete weeks.

Remainder 2

Look into Table II. p. 15. for this numeral character 2, and it will be found over against Tuesday, which is the day of the week required.

We say then, that an. ær. Nabonaf. 547, A. M. 3807, the sun came to the autumnal equinox, at Alexandria,

On Tuesday, Mefori 18d. 4h. 28m. P. M.

Thus the sixth article of enquiry is satisfied.

The Ninth ARTICLE of ENQUIRY.

At what precise distance before the autumnal equinox, did the M. full moon happen? In other words, what was the M. astronomical full-moon epact?

I have here set down the Ninth Article of Enquiry before the Seventh and Eighth, it being first necessary to calculate the M. astronomical epact, as it is the adequate measure of the distance between the moment of an equinox or a solstice, and the moment of a M. full or new moon, which comes next before it.

As soon as you shall find yourself able to ascertain the M. astronomical epact with precision, you will then, and not till then, be able to bring the sun and moon to the same, or exactly opposite meridian, with equal precision, by your tabular numbers. I hope to see an instance of this—in your next Critical Review.

The calculation of the M. astronomical epact is a very nice, and a very difficult operation; to effect it, I shall apply to the subjoined tables, not as the only, but as a curious and never-failing method, although upon principles not generally known.

TABLE I.

Exhibiting 19 autumnal-equinoctial full-moon epacts, for the first 19 years of the world.

Golden Numbers.	D.	H.	'	"	'''
1	10	21	00	39	00
2	21	18	1	18	00
3	3	2	17	55	15
4	13	23	18	34	15
5	24	20	19	13	15
6	6	4	35	50	30
7	17	1	36	29	30
8	27	22	37	8	30
9	9	6	53	45	45
10	20	3	54	24	45
11	1	12	11	2	00
12	12	9	11	41	00
13	23	6	12	20	00
14	4	14	28	57	15
15	15	11	29	36	15
16	26	8	30	15	15
17	7	16	46	52	30
18	18	13	47	31	30
19	29	10	48	10	30

TABLE II.

Exhibiting a series of Cyclic numbers, calculated for 300 decennoval Cycles. See my System of Chronology, p. 275.

Cycles.	D.	H.	'	"	'''
1	0	1	55	51	15
2	0	3	51	42	30
3	0	5	47	33	45
4	0	7	43	25	00
5	0	9	39	16	15
6	0	11	35	7	30
7	0	13	30	58	45
8	0	15	26	50	00
9	0	17	22	41	15
10	0	19	18	32	30
20	1	14	37	5	00
30	2	9	55	37	30
40	3	15	14	10	00
50	4	0	32	42	30
60	4	19	51	15	00
70	5	15	9	47	30
80	6	10	28	20	00
90	7	5	46	52	30
100	8	1	5	25	00
200	16	2	10	50	00
300	24	3	16	15	00

The PRACTICAL APPLICATION.

Divide A. M. 3807 by 19, and the quotient will give 200 complete cycles, leaving in the remainder 7 years of the 201st.

By Table II. 200 cycles give 16d. 2h. 10' 50" 00". From 16d. throw off 1, and there will remain 15d. 2h. 10' 50" 00" to be subtracted.

The

The remainder 7 is the golden number, which points out this epact, 17d. 1h. 36' 29" 30'''.

	D.	H.	'	"	'''
From the epact	17	1	36	29	30
Subtract for 200 cycles	15	2	10	50	00

The full moon astronomical epact, sought

1	23	25	39	30
---	----	----	----	----

We say then, that the precise distance of M. full moon before the autumnal equinox, an. ær. Nabonnass. 547, A. M. 3807, was 1d. 23h. 25' 39" 30'''.

Thus the ninth article of enquiry is satisfied.

The Seventh ARTICLE of ENQUIRY.

In what Egyptian month, on what day of the month, at what hour and minute, did the mean time of that eclipsed full moon happen, at Alexandria, in the given year?

The CALCULATION.

	D.	H.	'	"	'''
From the M. D. H. and M. of ☉ in $\simeq$, at Alexandria, Mefori	18	4	28	00	00
Subtract the M. astronomical epact					
	1	23	25	39	30
The Egyptian M. D. H. and M. of full moon, at Alexandria	16	5	2	20	30 P.M.

Thus the seventh article of enquiry is satisfied.

The Eighth ARTICLE of ENQUIRY.

On what day of the week did this M. full moon happen, in the given year?

But this requires no distinct calculation at all; for if the 18th of Mefori fell upon a Tuesday, it is certain that the 16th must have fallen upon a Sunday. And so it would be found by calculation.

Thus the eighth article of enquiry is satisfied.

The Tenth ARTICLE of ENQUIRY.

What was the difference between the M. time of this eclipsed full moon and the recorded middle time?

This scarcely can be called an article of enquiry; for,

	D.	H.	'	"	'''	
If from Mefori	16	7	00	00	00	P. M. the recorded middle time,
We subtract Mefori	16	5	2	20	30	the calculated M. time,
The remaind. is the diff. sought		1	57	39	30	

Thus the tenth article is satisfied.

The Eleventh ARTICLE of ENQUIRY.

Whether the numbers, which, in the tables of lunar equations, should answer to this difference, must be sought for within or without the limits of Nature?

If I recollect rightly, the limits between the M. time of a new or full moon, and the true, are oh — 14h. but it is certain, that a difference somewhat less than 2 hours falls within those limits, and consequently within the limits of Nature.

Thus the eleventh article of enquiry is satisfied.

I inserted this article purely with respect to a remark of yours, which not a little surprised me, and which I shall now cite.

Critical Review for November 1763, p. 347, signed, James Ferguson.

—“ Thus much I am absolutely certain of, that, however unable I may be to construct astronomical tables, I know enough to make me bold to say (as your measures now stand) whoever will try to find out such equations,”—as may answer to them, “ must first resolve to go out of the course of nature for them.”

As

As you only can interpret the true meaning of this remark; so I expect an interpretation thereof—in your next Critical Review. But be pleased to remember, that it will be an interpretation of your own dream, and not of mine.

The Twelfth ARTICLE of ENQUIRY.

Whether this difference be additive or ablative?

But it being intuitively certain, that it must be additive, I need say no more about it.

Thus all the twelve articles of enquiry are satisfied; and there nothing more remains but to compare your answers and mine together.

It will be but to little purpose to object, what I acknowledge to be true, that my numerical calculations cannot determine whether there would have been an eclipse or not. But to balance this, I will tell you, and mark what I say, that my numerical calculations, plain and simple as they are, bring me much nearer to the recorded middle time, than physiological principles, under the direction of your tabular measures and numbers, can bring you; for they cannot help you to ascertain so much as the day of the month, either Egyptian or Julian, on the evening of which this eclipse was said by Ptolemy to have been observed. See my Preface to VII. Letters addressed to the Reverend Dr. Blair. A conviction of this, one might reasonably conclude, would not only abate something of your confidence, but also put you upon thinking a little concerning the necessity of future improvements, and how to go about it. I wish you success in the undertaking.

In the next place, I shall confirm the truth of the preceding conclusions, to the precision of a moment, by bringing the Egyptian form of year down to the 18th century of Christianity; then taking for a radix that M. full moon, which came next before the autumnal

tumnal equinox, A. D. 1763, calculate backward from thence through an interval of near 2000 years.

To A. D. 1763 add A. M. 4007, and we shall have A. M. 5770; from which subtract A. M. 3807, and it will leave for the interval 1963 years.

To 1963 add the year from Nabonassar 547, and the sum 2510 will be the Julian year from Nabonassar, falling in with A. D. 1763.

From 2510 subtract, for a complete Sothiac period, 1460 years, and it will leave, in remainder, 1050 years; which being divided by 4, will give in the quotient 262 days, for the retrocessions of Thoth.

Required the Egyptian M. D. H. and M. on which the sun came to the autumnal equinox, at Alexandria, in the Julian year from Nabonassar, 2510, A. D. 1763.

To Pharmuthi 2d. 4h. 28m. P. M. (see the calculation, p. 54.) add the retrocessions of Thoth, in 1963 years, and the sum will be 264d. To this sum add, for 7 equal months, 210 days, then we shall have 474 days; from hence subtract 365, the days in 1 year, and it will bring it down to the 109th day, reckoning from the first of Thoth inclusive.

From 109 subtract for 3 equal months (namely, Thoth, Paophi, Athyr) 90 days, and we shall have Choiac 19d. 4h. 28m. P. M.

1963 Julian years being multiplied into 11', will produce 14d. 23h. 53m. for the retrocessions of the equinox in that interval.

But because the year 2510 was the 2d year of a quadriennium, and the year 547 was the 3d; this difference of 1 year in a quadriennium, will cause a difference of 6 hours in time. To 14d. 23h. 53m. add 6 hours, then the sum to be subtracted will be 15d. 5h. 53m.

D. H. M.
From Choiaç 19 4 28 P. M.

Subtract for the retrocessions of the equinox in 1963 years	}	15 5 53
		3 22 35 P. M. ☉ in ♈, at Alex- andria, An. 2510, A. D. 1763.

There will remain Choiaç

Required the M. astronomical full-moon epact, or the precise M. distance of full moon, before the autumnal equinox, An. 2510, A. D. 1763.

If we divide A. M. 5770 by 19, the quotient will give 303 complete cycles, leaving in the remainder the 13th year of the 304th.

303 cycles give, by Tab. II. p. 56, 22d. 9h. 3' 48" 45", having thrown off 2 days.

	D. H. ' " "	
The golden number 13, Tab. I. points out this epact	}	23 6 12 20 00
Subtract for 303 cycles	}	22 9 3 48 45
The M. astronomical full-moon epact		21 8 31 15

	D. H. ' " "	
From Choiaç		3 22 35 00 00 ☉ in ♈, at Alex- andria,
Subtract the M. F. M. epact		0 21 8 31 15
The Egyptian M. D. H. and M. of M. full moon	}	3 1 26 28 45 P. M. at Alexand. An. 2510, A. D. 1763.

Required the exact astronomical measure of the distance between that M. full moon which came next before the autumnal equinox, in the Julian year from Nabonassar 2510; and that M. full moon which came next before the autumnal equinox, in the year from Nabonassar 547. The interval 1963 years.

1963 Julian years produce 71698d. 18h. 00m.

1963 tropical years include 21279 lunations, which produce 716872d. 20h. 24' 8" 15".

From

	D.	H.	'	"	'''
From the Julian reduction	716985	18	00	00	00
Subtract the lunar	716872	20	24	8	15
Remains the astronomical measure sought	12	21	35	51	45

But here we must argue as we did above. Because the year 2510 was the second year of a quadriennium, and the year 547 was the third; this difference of a year in a quadriennium, will cause a difference of 6 hours in time; therefore to 12d. 21h. we must add 6 hours, and then the astronomical measure will be 13d. 3h. 35' 51" 45''' to be added.

Divide 1963 by 4, and the quotient will give 490 days, from which subtract 365, and it will leave in remainder 125 days for the retrocessions of Thoth, in that interval.

To Choiaç 3d. add for 3 equal months 90 days, and the sum will be 93 days; to which add 365, and we shall have 458 days; from which subtract 125 for the retrocessions of Thoth in 1963 years, and it will leave in remainder 333 days, reckoning from the first of Thoth inclusive. From 333 days subtract 330 for 11 equal months, and it will bring it down to Mefori 3d. 1h. 26' 28" 45''' P. M. for the M. time of full moon next before ☉ in ♌, An. 2510, A. D. 1763.

I call this the Julian station of the moon, every year being now made to consist of 365d. 6h. the biffextile days being all restored.

To M. time of full moon	}	D. H. ' " '''					
next before ☉ in ♌,		3 1 26 28 45					
Mefori _____							P. M. An. 2510,
Add for the astronomical	}	13 3 35 51 45					A. D. 1763.
measure _____							
M. full moon next before	}						
☉ in ♌, at Alexan-		16 5 2 20 30					
dria, Mefori _____							P. M. An. ær. Na-
							bonaf. 547.

Now

Now I am to prove, from this calculated M. time of full moon, that this eclipse might have been visible at Alexandria, at the time recorded by Ptolemy ; and I shall prove it by your own express testimony, signed by your own name at length.

		D. H. ' " "					
1.	To	Mefori	16	5	2	20	30 p. m. M. time of full moon at Alexandria,
	Add	—			53		
We shall have	Mefori	16	5	55	20	30	P. M. the eclipse began ;
Add	—			7			the moon being now under the horizon of Alexandria.—Witness <i>James Ferguson</i> .
We shall have	Mefori	16	6	2	20	30	P. M. the moon on the horizon at Alexandria, but not visible. — Witness <i>James Ferguson</i> .
Add	—			20			
We shall have	Mefori	16	6	22	20	30	P. M. the moon above the horizon of Alexandria, and the eclipse visible.—Witness <i>James Ferguson</i> .
Add	—			37	39	30	
We shall have	Mefori	16	7	00	00	00	P. M. the middle time of the eclipse, computed to the nearest hour.—Witness <i>Ptolemy's Record</i> , l. 4. c. 11.

Thus Mr. Kennedy has shewn, by calculating downwards from the time of his original full moon, through an uninterrupted series of 47086 lunations (for so many lunations are included in 200 cycles + 7 years, or in 3807 tropical years) that this eclipse might be visible at Alexandria at the time recorded by Ptolemy ; and his reward is to be—no less a profelyte to the truth of the fundamental principles of his system, than a Profest Astronomer, and our Table-Maker in Chief.

But although I have performed, by your own express testimony, this notable feat ; as much, perhaps, beyond your wishes, as it certainly was beyond your expectations ; if your own declarations of impossibility may

may be credited : instead of behaving myself like one flushed with victory, and quite intoxicated with the fullness of success ; I shall be modestly cool ; and, without thinking it worth my while, publicly to demand of you a punctual performance of your voluntary engagement, I shall leave you, with a perfect indifference, to your own sense of honour.

But let Mr. Ferguson remember, that he has a scrap of reputation to lose.

I now proceed to the

JULIAN COMPUTATION,

Both Solar and Lunar.

I am to calculate the same equinoxes and full moons in the Julian form of year, as I have already done in the Egyptian : this mode of proceeding may probably render the calculations more intelligible to you, as they will lie in your own path, to which you have been so long familiarised : as for Egyptian months, and Sothic periods, you may look upon them, perhaps, as uncouth and out-of-the way things.

We will first go through, and settle the several branches of the Julian solar computation.

In order to this, let it be required to find, 1st, The tropical year, before the vulgar year of Christ's birth 0. 2dly, The Julian year, before the vulgar year after Christ's birth 1. 3dly, The year of the Julian period corresponding with the year from Nabonassar 547, and with the year of the world 3807.

1st, From A. M. 4007 subtract A. M. 3807, and the difference 200, will be the tropical year. 2dly, From A. M. 4008 subtract A. M. 3807, and the difference 201, will be the Julian year. 3dly, From A. J. P. 4713, which answers to the year of Christ's birth 0, subtract 200, and it will carry it back to the year of the Julian period 4513, which falls in with the year from Nabonassar 547, and the year of the world 3807.

Required

Required the Julian month, day, hour, and minute, on which the sun came to the autumnal equinox, at Alexandria, an. ær. Nabonass. 547, A. M. 3807.

Here it will be necessary to subjoin

A T A B L E

Of the times of the Sun's entry into the four Cardinal Points of the Ecliptic, for the first four Years of the Reign of Nabonassar, in the Months and Days of the Julian Year, calculated for the Meridian of Alexandria.

Years after Biffex.	Years of the world.	☉ in ♈ Month March.	☉ in ♊ Month June.	☉ in ♏ Month Sept. Octob.	☉ in ♍ Month Decemb.
		D. H. M.	D. H. M.	D. H. M.	D. H. M.
1	3260	— — —	— — —	— — —	29 6 42 P.M.
2	3261	28 8 43	29 7 25	30 20 34	29 12 31
3	3262	28 14 32	29 13 14	Oct. 1 2 23	29 18 20
Bisso	3263	27 20 21	28 19 3	Sep. 30 8 12	29 0 9
1	3264	28 2 10	29 0 52	30 14 1	29 5 58

A. J. P. 4513 was a biffextile year. I look into the table for A. M. 3263, and in the same parallel line, under ☉ in ♏, I find these times, September 30d. 8h. 12m. P. M.

The interval, by a preceding calculation, is 544 years, which give for the retrocessions of the equinox 4d. 3h. 44m. (see p. 54).

D. H. M.

From September 30 8 12 P. M. ☉ in ♏, an. ær. Nabonass. 3, at Alexandria,

Subtract 4 3 44

The Jul. M. D. H. }
and M. required, } 26 4 28 P. M. an. ær. Nabonass. 547, A. M.
September } ————— 3807.

2dly, The astronomical connection of the 26th of September with the 18th of Mefori, (the calculated day of the autumnal equinox in the Egyptian year,

K

an.

an. ær. Nabonass. 547, A. M. 3807) may be proved from the Table of Radical Numbers for Equinoxes and Solstices. See Letter IV. p. 30.

The CALCULATION.

3807 Julian years, being multiplied into 11', will produce 29d. 1h. 57m. for the retrocessions of the equinox, in that interval; subtract for the meridian of Alexandria, 12h. 25m. and it will leave 28d. 13h. 32m.

A. J. P. 4513 was bissextile; therefore the radical numbers (see the Table, Letter IV. p. 30.) are October 24d. 18h. 00m. Add, to make the subtraction, the 30 days of September, and the sum will be 54d. 18h. 00m.

D. H. M.	
	From 54 18 00
Subtr. for the merid. } of Alexandria	28 13 32
Jul. M. D. H. and } M. of ☉ in ♎, } September	26 4 28 P. M. an. ær. Nabonass. 547, Alexandria.

3dly, The astronomical connection of the 26th of September with the 18th of Mefori, may be proved, by a calculation downward from the Julian station of the original autumnal equinox to the given year; through an uninterrupted series of 3807 Julian and tropical years.

The CALCULATION.

	D.	H.	M.
3807 Julian years produce	1390506	18	00
Subtract for the retrocessions of the equinox	29	1	57
Remains, the solar tropical reduction	1390477	16	3
Add for the Julian station of the original autumnal equinox, Oct. 25d. 00h. 00m.			
A Kal. Jan.	298		
	1390775	16	3

		D.	H.	M.
	To the sum	1390775	16	3
Add for the meridian of Alexandria	—		12	25
	From the sum	1390776	4	28
Subtract for the Julian reduction, adding 1	—			
for biffextile day	—	1390507	0	00
Jul. M. D. H. and M. of ☉ in ♈, as before,				
September 26	—		269	4 28P.M.

4thly, The astronomical connection of the 26th of September with the 18th of Mefori may be proved, by a calculation backward to the given year of Nabonaf. 547; taking for a radix the calculated time of the autumnal equinox, in the meridian of Alexandria, A. D. 1763, A. M. 5770.

The CALCULATION.

Required the Julian M. D. H. and M. of the autumnal equinox, at Alexandria, A. D. 1763, A. M. 5770.

5770 Julian years, being multiplied into 11', will give for the retrocessions of the equinox 44d. 1h. 50m. from which subtract, for the meridian of Alexandria, 12h. 25m. and it will leave 43d. 13h. 25m.

A. D. 1763 was the 3d after biffextile; therefore the radical numbers are Octob. 25d 12h. 00m. Add, to make the subtraction, the 30 days of September, and the sum will be 55d. 12h. 00m.

	D.	H.	M.	
	From	55	12	00 P. M.
Subtract, for the				
merid. of Alex		43	13	25
andria,				
Jul. M. D. H. and				
M. of ☉ in ♈,		11	22	35
September				
				P. M. at Alexandria, A. D. 1763,
				A. M. 5770.

Required the Julian M. D. H. and M. of ☉ in ♈, at Alexandria, an. ær. Nabon. 547, A. M. 3807.

K 2

From

From A. M. 5770 subtract A. M. 3807, and it will give an interval of 1963 years. 1963 Julian years being multiplied into 11', will give, for the retrocessions of the equinox, 14d. 23h. 53m. But because A. M. 5770 is the 2d year of a quadriennium, and A. M. 3807 is the 3d, this difference of a year in a quadriennium will cause a difference of 6 hours in time; to 23 hours add 6, and then we shall have 14d. 5h. 53m. for the numbers to be added.

D. H. M.

To Sept. 11 22 35 P. M. ☉ in ♈, at Alexandria,
A. D. 1763, A. M. 5770,

Add 14 5 53

Julian M. D. H. and } 26 4 28 P. M. at Alexandria, an. ær,
M. of ☉ in ♈, Sept. } Nabonaf. 547, A. M. 3807.

5thly, The astronomical connection of the 26th of September with the 18th of Mefori, may be proved, by a calculation backward to the given year; taking for a radix the observed time of the autumnal equinox at Greenwich, A. D. 1752, O. S. September 11d. 4h. 35m.

To A. D. 1752 add A. M. 4007, and we shall have A. M. 5759; from which subtract A. M. 3807, and it will give for the interval 1952 years.

To the observed time of the autumnal equinox at Greenwich, A. D. 1752, O. S. Septem. 11d. 4h. 35m. add 2h. 1m. to bring the time to Alexandria, and we shall have September 11d. 6h. 36m.

D. H. M.

To Sept. 11 6 36 P. M. ☉ in ♈, at Alexandria,
A. D. 1752, A. M. 5759.

Add, for the retrocessions of the equinox } 14 21 52
in 1952 years }

Julian M. D. H. and } 26 4 28 P. M. at Alexandria, an. ær.
M. of ☉ in ♈ } Nabonaf. 547, A. M. 3807.

6thly, The astronomical connection of the 26th of September with the 18th of Mefori, may be proved, by

by computing from the 28th of February, the true Julian station of the æra of Nabonassar. For a full explication and proof of this, see my VIth Letter to the Reverend Dr. Blair.

The CALCULATION.

To February 28 add the 31 days of January, and to the sum 59 add 365, and from the sum 424 subtract 1, to carry it back to the end of the preceding year.

Divide 547 by 4, and the quotient will give 136 days for the retrocessions of Thoth.

From 423 subtract 136, and it will carry it back to October 14, à Kal. Jan. 287d. Mefori is the 12th month of the Egyptian year; to Mefori 18, add for 11 equal months, 330d. and the sum will be 348d. To 287 add 348, and from the sum 635 subtract 366 for a biffextile year, and it will bring it down to September 26, à Kal. Jan. 269d. for the Julian month and day of the autumnal equinox, as in the preceding calculations; which was to be proved.

In the next place, we must go through, and settle the several branches of the Julian lunar computation.

1st, Required the Julian month, day, hour, and minute, on which the M. full moon happened, which came next before the autumnal equinox, an. ær. Nabonass. 547, A. M. 3807.

I shall begin with the M. full-moon epact, which being subtracted from the month, day, hour, and minute, of the autumnal equinox, will give the month, day, hour, and minute of M. full moon which came next before it, in the same meridian, both in the Julian and the Egyptian year.

The CALCULATION.

3807 tropical years produce 1390477d. 16h. 3m.

This

[70]

This number of tropical years includes 47086 lunations.

47086 lunat. produce 1390476d. 16h. 37' 20" 30".

	D.	H.	'	"	'''
From the tropical reduction	1390477	16	3	00	00
Subtract the lunar, less by 1 day	1390475	16	37	20	30
The M. astronomical full-moon epact	1 23 25 39 30				

	D.	H.	'	"	'''		D.	H.	'	"	'''								
From ☉ in ♈,	26	4	28	00	00	Mefori	18	4	28	00	00								
at Alexandria,																			
September						An.													
Subt. the M.						547.													
full-moon e-	1 23 25 39 30						1 23 25 39 30												
paet																			
Jul. & Egypt.	24	5	2	20	30		16	5	2	20	30								
M. D. H. and																			
M. of M. full																			
moon, Sept.																			

2dly, the astronomical connection of the 24th of September with the 16th of Mefori, the recorded day of the eclipsed full moon, may be proved, by a calculation from the Julian station of the original full moon downward to the year of the Julian period 4513, through an uninterrupted series of 3807 years, which include 47086 lunations.

The CALCULATION.

	D.	H.	'	"	'''
47086 lunations produce	1390476	16	37	20	30
Add for the Julian station of the original full moon,					
Oct. 24d. ooh. oom. à Kal. Jan. 207					
To the sum	1390773	16	37	20	30
Add for the meridian of Alexandria					
			12	25	
	1390774	5	2	20	30

From

[71]

	D.	H.	'	"	'''
From the sum	1390774	5	2	20	30
Subtract for the Jul. reduction of 3807 years, adding 1 for the bissextile day	1390507				

The Jul. M. D. H. and M.
of M. full moon, next be-
fore ☉ in ♈, as before,
September 24 ————— 267 5 2 20 30 P. M. an. 547.

3dly, The astronomical connection of the 24th of September with the 16th of Mefori, may be proved, by a calculation backward to the year of the Julian period 4513, through an interval of 1963 years; taking for a radix that M. full moon, which came next before the autumnal equinox, A. D. 1763, A. M. 5770.

The Calculation.

A. D. 1763, A. M. 5770, the sun came to the autumnal equinox at Alexandria (see the calculations, p. 67.) September 11 d. 22 h. 35 m. P. M.

Before we can determine the time of M. full moon, which came next before the equinox, we must ascertain the M. astronomical full-moon epact.

5770 solar tropical years produce 2107448 d. 10 h. 10 m. The included number of lunations is 71365, which produce 2107449 d. 13 h. 1' 28" 45"', from which throw off 2 days, and there will remain 2107447 d. 13 h. 1' 28" 45'''.

	D.	H.	'	"	'''
From the solar tropical reduction	2107448	10	10	00	00
Subtract the lunar, less by 2 days ———	2107447	13	1	28	45
The M. astronomical full-moon epact required	0	21	8	31	15

From

[72]

D. H. ' " "

From Sept, 11 22 35 00 00 P. M. ☉ in ♌, Alex-
and. A. D. 1763.

Subt. the F. M. epact 00 21 8 31 15

Jul. M. D. H. and M. of	}								
M. full moon before		11	1	26	28	45	P. M.	A. D.	1763,
☉ in ♌, September									A. M.
Add for the astronomical	}								
measure, see p. 62.		13	3	35	51	55			

Jul. M. D. H. and M. of	}								
full moon before ☉ in		24	5	2	20	30	P. M.	An	547, A. J. P.
♌, September									4513.

4thly, The astronomical connection of the 24th of September with the 16th of Mefori, may be proved by a calculation downward from the Julian station of the original full moon, to the year of the Julian period 4513, A. M. 3807, upon the principles of the Jewish computation.

A minute and circumstantial explanation of the Jewish form of year, and the methods used by the Jews in calculating the annual returns of their festival full moons, may be seen in my System of Chronology, from p. 417 to p. 432. And, for brevity's sake, I shall refer to the several tables, which are necessary in calculations of this nature, and are there set down, p. 426, 427, 428.

A CALCULATION after the JEWISH Manner.

	A. M.
Divide by 19)	3807 (200 decennial cycles.
Remain	7 years of the 201st.

[73]
D. H. ' " ///

Tab. I. Syst. of Chronol.	
p. 426. The characters of 200 cycles, are	05 01 30 50 00
Tab. III. p. 427. The characters of 5 common lunar years	0 20 1 45 00
Tab. IV. p. 427. The characters of 2 embolimæan years,	4 19 4 45 30
The characters of the original full moon,	3 0 0 0 0
Add for the meridian of Alexandria	0 12 25 0 0
The characters of full moon in Septem. A. J. P. 4513, are, as above, Sunday	0 5 2 20 30 P. M. Alexandria.

Required the corresponding Julian month, and day of the month.

	D. H. ' " ///
Tab. V. 427. The Julian excess in 200 cycles, is	12 22 29 10 00
Tab. VI. 428. The Julian excess in 5 common lunar years	54 9 58 15 00
Tab. VII. p. 428. Subtract for the excess of 2 embolimæan years above the Julian	37 7 4 45 30
To the remainder	17 2 53 29 30
Add the Julian excess in 200 cycles	12 22 29 10 00
From the sum	30 1 22 39 30
Subtract for the meridian of Alexandria	00 12 25 00 00
Remainder	29 12 57 39 30
From the radical numbers, for full moons, in a bissextile year, October	23 (53) 18 00 00
Subtract, for the meridian of Alexandria	00 29 12 57 39 30
Jul. M. D. H. and M. of M. full moon at Alexandria, A. J. P. 4513, as before September	00 24 5 2 20 30

5thly, The astronomical connection of the 24th of September with the 16th of Mefori, may be proved, by computing, from the 28th of February, the true Julian station of the æra of Nabonassar.

The CALCULATION.

It has been already observed, that if we divide the year from Nabonassar 547 by 4, it will give 136 days for the retrocessions of Thoth. Mefori is the 12th month of the Egyptian year; if to Mefori 16 we add, for 11 equal months, 330 days, the sum will be 346d. To October 14 à Kal. Jan. 287, add 346, and from the sum 633, subtract 366 for a bissextile year, it will bring it down to September 24 à Kal. Jan. 267d. the Julian month and day of full moon, next before the autumnal equinox, in the given year, as in the preceding calculations; which was to be proved.

When I take a review of this variety of conclusions, and observe how exactly they agree with each other, a circumstance occurs to my thoughts, which must, I think, greatly perplex you. Suppose you to be quite convinced, by the evidences and proofs which I have given of it, that they who originally fixed the Julian station of the æra of Nabonassar to the 26th of February, have really committed an error of 2 days current; yet, notwithstanding these evidences and proofs, and such a thorough conviction of the error, on your part, that you should think yourself obliged from henceforward, to compute from the 28th of February, and not from the 26th; yet in your calculations backward to the year of the Julian period 4513, your tables will still find a full moon, 1st, on the 22d of September, instead of the 24th; 2dly, on the 14th day of Mefori, instead of the 16th; 3dly, on a Friday, instead of Sunday; 4thly, within 4 days, instead of 2 days, before the autumnal equinox; 5thly, to sum up the whole in a word, your tables will still find an eclipse in September, A. J. P. 4513, 2 days before there was any full moon in the heavens; as I have clearly manifested to you in my Preface, which you have not yet reviewed, as I can hear of.

Should

Should this account appear, upon trial, to be true in fact, can you still think yourself under no special obligation to amend and improve your inaccurate tabular measures, and so erroneous calculations founded upon them? If you can, then why may not I take the liberty to think, in my turn, that your prejudices have got the better of your reason and your judgement? But I hope better things of you, although I thus speak.

But I have not yet finished my task; another demand of yours calls upon me to satisfy it, or I am likely to lose my credit with you, as far as I can judge from the peculiar and peremptory style, in which you make your demand.

Critical Review for November 1763, p. 344, 345.

“ You will undoubtedly, say you, abide by your own numerical measures; and to them I shall now bind you down.

“ And now from the time of new moon, in April, 1764, as calculated by yourself, from your own measure of a lunation, &c. you are here called upon to calculate backward, so as to give us the mean time of full moon, at Alexandria, in September, in the year before Christ 101, which full moon, according to Ptolemy, rose eclipsed in that place.”

As I now know what I have to do, I shall with all readiness set about it; but perhaps you will pardon a digression or two, should circumstances render them proper and seasonable.

It is well known, that the new moon which happened next after the vernal equinox, A.D. 1764, caused an eclipse of the sun, visible in our meridian, on Sunday, the 1st of April, between the hours of ten and eleven in the morning: but as far as I can recollect, in the place where I saw it, it was not so near to being total, as some took upon them to predict.

At the time of this eclipse, the moon, you tell us,
was

was making near approaches to her apogeeal point; it is greatly to be wished, that at the very moment of the middle time, the moon had arrived at the very point of her apogee; such a lucky circumstance would have made a full discovery whether there was any defect in my length of a mean lunation, or not. And yet one might reasonably imagine, that I had already given sufficient proofs of its mathematical exactness; and I shall give you more in the calculations which I have now in hand: and yet, perhaps, all may not be sufficient to awaken you out of that dream of fancy, which has deluded you into an opinion, that I had shortened the length of my mean lunation, to suit it to a radix that was ignorantly fixed 27 hours too late.

Now, had you rightly understood the subject, upon which a crotchet in your head prompted you to write and publish, what you call Critical Remarks, you would not have said 26 or 27, but you would have said full 50 hours too late. For,

1st, With so much error I charge your tabular calculation of M. full moon, in October, A. J. P. 706, namely, October 22d. 8h. 5m. P. M.

2dly, I charge your tabular time of the autumnal equinox in the same month, and in the same year, namely, October 23d. 16h. 57m. P. M. with an error of full 41 hours; for so much it falls short of the true time of the equinox, in your tabular meridian, exclusive of the minutes.

3dly, I charge you with differing from yourself, no less than 50 hours, with respect to a former calculation, of the same full moon, and the same equinox; when the times of the equinox, and the distances of full moon before it, are compared together.

4thly, I leave you to exculpate yourself from this threefold accusation, at your leisure.

As I am upon the article of accusation, I must not let slip this occasion to take some notice of the irreconcilable difference between the times of your tabular calculation of full moon in September, in the Julian year

year 201 A. C. and those of mine. The comparison may be easily made. For,

	D. H. ' " "		D. H. ' " "
From the re- corded mid- dle time, Me- fori	} 16 7 00 00	And from, Sept. 24	7 00 00 P.M.
Subtract your tabular time			
	14 7 26 28		22 7 26 28
The differ- ence of the times, is,	} 1 23 33 32		1 23 33 32

These 47h. 33m. 32" is the sum of your tabular error; and this sum divides itself into 3 distinct parts.

1st, Into 12h. 18' 20", which you call the sum of the lunar equations to be subtracted, from what you call your tabular mean time: but you might with much more propriety have considered these 12h. 18' 20", as an unmeaning, insignificant redundancy, which only serves to increase the tabular error of mean time, in exact proportion to its quantity.

2dly, Into 9 hours, and odd minutes, which you are to account for; and if you cannot, I must.

3dly, Into 1 entire day, which you are likewise to account for; and if you cannot, I must.

To 9h. add 12h. and the sum will be 21h. concerning these 21h. or 22 hours nearly, you have with great freedom expressed your sentiments, as may be seen in the citation of them.

Critical Review for November 1763, p. 346.

" By calculating backward, from your measure of a
 " lunation, from the mean time of new moon in
 " April, 1764, (as given by yourself, in which you
 " come *very near* the truth) through all the lunations
 " up to the above times, I find that in this eclipse, in
 " September, in the year before Christ 201, your
 " numbers make the time to have been *almost* 22 hours
 " after.

“*after the moon rose;*”—(—You should have said, about 55 minutes before the eclipse began, see the preceding calculations, p. 63.) “so that she was then below the horizon, and within 3 hours of rising in the morning, after the eclipse happened. And consequently, according to your measures”—And your own express testimony to the contrary, see p. 63. —“no such eclipse could be visible at Alexandria.”

Now whether you was in a state of intoxication, or in a downright delirium, when you thus blindly criticised, and thus rashly judged, I take not upon me to say. But the real matter of fact is as follows.

Mr. Ferguson himself made this bungling calculation; for I utterly disavow it, and every part of it. But through an inability to comprehend my mode of calculation, which he awkwardly attempted, he fell into mistakes, as almost necessarily he must. Then, as incredible as it may tell, he, with a *childish thoughtlessness*, charges me with errors committed by himself.

But, pray, Good Mr. Critic, may I not take the liberty to ask you a civil question? Is no apology due to me, for such a scandalous, such an ignominious affront? Is no recompence, no satisfaction to be made me, for the injury which you may have thereby done to my credit and reputation, as a computist, in the opinion of many?

Let the candid and unprejudiced reader judge.

As these necessary digressions carry along with them their own excuse, I shall not lose time in making studied apologies for them; but, without more delay, I shall enter upon my task.

First, Required the M. new moon, next after the vernal equinox, in the meridian of Alexandria,
A. D. 1764.

The CALCULATION.

To A. D. 1764 add A. M. 4007, and we shall have A. M. 5771; subtract 6 months, and it will carry it
back

back from the autumnal to the vernal equinox: and now the astronomical measure of the interval between the autumnal equinox, A. J. P. 706, and the vernal equinox, A. D. 1764, A. M. 5771, will be 5770 tropical years, and 6 months.

5770 tropical years and 6 months include 71371 lunations and a half; if we terminate the account at that new moon which happened next after the vernal equinox, A. D. 1764.

These 71371 lunations and a half produce 210764^d. 11h. 47' 40" 7''' 30''', from which throw off 1 day, then to the remainder 210764^d. 11h. 47' 40" 7''' 30'''.

Add for the Julian station of the original full moon, October 24^d. 00h. 00m. à Kal. Jan. 297,

	D.	H.	'	"	'''	'''
To the sum	2107937	11	47	40	7	30
Add for the meridian of Greenwich	0 10 24 00 00 00					
From the sum	2107937	22	11	40	7	30
Subtract, for the Julian reduction of 5771 years, having thrown off 1 ^d . for new stile	2107847 00 00 00 00 00					
March 31	90	22	11	40	7	30
Add for the meridian of Alexand.	2 1 00 00 00 00					
New moon at Alexan. Apr. 1.	91	00	12	40	7	30
	P. M. A. D. 1764, A. M. 5771.					

2dly, Required M. full moon in September, in the Julian year 201, A. C. A. J. P. 4513, in the same meridian. Interval 1963 years, and 6m.

1963 tropical years and 6m include 24285 lunations and a half, computing backwards from the new moon in April, A. D. 1704. 24285 lunations and a half produce 717164^d. 19h. 10' 19" 37''' 30'''.

[80]

D. H. 1 11 11 11

To the reduction of 71371 luna- tions and a half	}	2107641	11	47	40	7	30	
Add, for the me- ridian of Alex- andria				12	25	00	00	00
From the sum		2107642	00	12	40	7	30	
Subt. for 24285 lunations and a half	}	717164	19	10	19	37	30	
To the remainder		1390477	5	2	20	30	00	
Add, for the Ju- lian station of the original full moon, October 24d. coh. oom. à Kal. Jan.	}		297					
From the sum		1390774						
Subt. for the Ju- lian biffextile reduction of 3807 years.	}	1390507						
M.F.M. at Alex- andria, as above, September 24		265	5	2	20	30	00	P. M. which was to be proved.

When I first read this last demand upon me, and observed how magisterially you urged me to a compliance, I could not imagine why you so earnestly pinned me down to my own numerical measures, which, when applied, are ever so astronomically true; or what could lead you to suppose, that I would decline a calculation, which I knew would not be attended, either with the least difficulty, or the least uncertainty: nor could I resolve this disposition and procedure of yours into any other cause, than to your not having right apprehensions and a thorough knowledge of my peculiar mode of calculation.

By what means you yourself produced such a bungling calculation, especially as you computed from my measure of a mean lunation, and from the same radical new moon, is an enigma, which every examiner cannot solve; neither can you, without my aid and assistance;

assistance; which you are very welcome to, whenever you are disposed to ask it.

I must not, upon this occasion, omit to observe, and with a secret satisfaction too, how literally true those two assertions of mine now appear to be; which seem to have ruffled you, as you did not let them pass unnoticed in your review.

My first assertion was, that your tables can neither confirm the truth of my calculations, nor convict them of error.

My second assertion was, that what you call the sum of your lunar equations, instead of correcting the M. time of new or full moon in a more remote age; they only correct (and frequently but in part) the sum of the error, arising from the excess of the tabular measure of a mean lunation, multiplied into the number of intervening lunations. I might have added, that they sometimes only increase the tabular error of M. time, in exact proportion to their quantity, as it has been already observed, in the present example.

A clear proof of the literal truth of these two assertions, must cause a little discomposure, and incline you secretly to wish, that you had behaved yourself rather with a little more civility, temper, and coolness.

Thus I have complied with your demands; and, with a ready obedience, have performed the task which you was pleased to impose upon me. May I venture to tell you, that I found the calculations, which you pronounced impossible, to be extremely easy? And you will find them, upon a critical examination, in all the variety of their parts, to be so accurately true, that "not the least particle of time can be added to, or "taken from them," without a sensible break in the mathematical precision.

Before I finish this letter, I shall just observe, in what high terms of recommendation you speak of tabular precision.

Critical Review, November 1763, p. 345.

“ By the particular characteristics wherewith this
 “ eclipse (namely, in September, in the Julian year
 “ 201, A. C.) and 3 other ancient ones, are distin-
 “ guished, which are the rising or the setting of the
 “ eclipsed luminaries, we can be at no loss as to the
 “ times, in which they were observed.”——Yes, you
 may, and very easily too. Should you ask how, I
 answer, By grossly miscalculating the day of the
 month, as you have done; and for a proof of it, I
 refer to my Preface to VII. Letters addressed to the
 Reverend Dr. Blair.

“ The recorded times of ancient eclipses, you say,
 “ must be allowed on all hands to be a sure test for
 “ trying the truth or falsehood of all our astronomical
 “ tables.”

If these things are so; if this be really true in fact;
 then I am emboldened to say, in my turn, that Mr.
 Ferguson has no more to do, but to deplore the final
 loss—may I not say, the total annihilation?—of all his
 tables, in plaintive elegiac strain; and the burden of
 his doleful ditty must be,

“ Eheu! nos miseros! omnes periere Tabellæ!”

J. K.

To Mr. James Ferguson.

L E T T E R II.

MY own experience dictates to me, that a man cannot be in a more grievous and irksome state, than to lie under a kind of necessity to contend with, and to undertake the defence of interesting points with a weak, injudicious, and very disqualified critic and opponent; such as I have found mine to be: and indeed, considering that he has been so many years a practitioner, I have found him so, in a much higher degree than I either should, or possibly could have suspected, if I had not scrutinised, what he calls Critical remarks upon the Astronomical part of my System of Chronology, with a more than ordinary attention.

I am well aware, that few, very few, if any, will concern themselves with such frivolous altercations as I am, at present, most disagreeably engaged in; and yet I could wish, that one or two sensible judges would deign to cast a transient glance upon the two following extracts; and try if they can discern any meaning at all lurking in the one; and any thing in the other, besides an open display of a most profound ignorance, even to a degree of stupidity. If they can, they will discover somewhat, which has escaped my utmost diligence and care.

Critical Review for November, 1763, p. 342.

“ The question between us, is, Whether you, or
 “ any body else, can calculate the true time of new
 “ and full moons, and eclipses, by your tables, which

“ you praise so highly,—*as you see the astronomers can do by theirs.*”—You should have said, as you see, and have clearly proved, that the astronomers *cannot* do by theirs ; unless we can overlook the small trifling error of full 47 hours, in the tabular time of full moon. See p. 77.

“ Which tables of the astronomers you altogether” (you should have added, and with so much reason and justice) “ condemn. “ This you know, Sir, can never be done by Your (lege, Our) tables, either with equations, or without them. And therefore, however useful your book may be to the mere Chronologer, and however exactly your boasted Coincidencies may (or rather indeed *must*) agree with the principles upon which you have constructed these tables, and may thereby *dazzle* and *deceive* the superficial scholar, and conceal from him the imposture of your method; yet they cannot deceive—” —one so Knowing, so Acute, so Learned, as Myself.

Ist, Pray, Mr. Critical Examiner, what can you possibly mean by the *imposture* of my method? Such vilifying, reproachful, and degrading terms, call aloud for a justifying comment; and by these presents I publicly demand it; and expect to see it—in your next Critical Review.

2. “ My boasted coincidences, you say, may, or rather must agree with the principles upon which my tables are constructed.”

These expressions seem to imply, that you are not unacquainted with the principles of their construction. Be pleased to give me some proof of it.

3. But is it not here natural to ask, how comes it to pass, that the coincidences, which I have thought worthy objects of my Boastings, cannot be brought to agree, in any one instance, in the like manner, with the principles and numbers, upon which your tables are constructed?

Whether this question does not merit both your notice and your answer, let every reader judge.

These

4. These coincidences of the times, which, through ignorance, you treat with such affected contempt, exhibit as convincing a proof of *absolute perfection* in practical astronomy, as can be given by the most experienced, and the most accurate calculator. But I must tell you, Mr. Critic, that you show such a total disregard to precision in all your Tabular calculations, and are thereby become such an utter stranger to it, that you really do not know it, even when you have ocular proof of it.

“ —————Pudet hæc opprobria vobis
“ Et dici potuisse, et non potuisse refelli.”

Critical Review for November 1763, p. 350.

“ You say,”—and I say it still—“ that no Tables
“ extant, besides your own, can give the same con-
“ clusions, if we calculate both upward and down-
“ ward from them—Indeed they never can, if you
“ try them by the same unfair methods that you have
“ done Meyer’s.”

—Here you discover an *entire want* of *apprehension* ;
as it may undeniably appear upon a more proper
occasion.

“ But since you are so prodigiously charmed with
“ this wonderful coincidence in your tables, pray
“ attend to the self-evident truth in the following ex-
“ ample, without having recourse to any tables at all.

“ Multiply 10 by 8, and set down the product ——— 80

“ Then divide 10 into two parts, as 3 and 7.

“ And take their products by 8, which are 24 and 56.

“ Their sums make ——— 80

“ Subtract, and there remains ——— 00

“ Your example, p. 452, is precisely of this kind.”

—One might imagine that Mr. Ferguson, after so
many years experience, might have been better skilled
in science, than to reckon a mere numerical and
mecha-

mechanical, and a true astronomical conclusion, absolutely depending upon the mathematical length of a mean lunation—Homogeneous.

“ Yet you say,”—and I say so still—“ that your conclusion is very remarkable and very singular, because no other tables can produce such coincidence.”

—I will give you my certificate, if you please, that your tables cannot produce any astronomical coincidence at all.

“ A most wonderfull coincidence this! strange indeed! that if you count 5 inches forward, from the end of a foot rule, and 7 inches backward from the other end, both your reckonings shall end at the same point.”

—What? and in an exact coincidence with the M. time of a new or full moon, calculated for a given meridian, from different radix's, and through opposite and unequal intervals? More proofs still, of the same profound ignorance, and in the same degree of stupidity.

The humane and benevolent reader will lament with me my hard lot, when he sees into what incompetent hands I am fallen.

“ And yet, *amidst all this trifling*, you have been cautious enough”——

As what follows is somewhat in my favour, and as my present design is to lay open your ignorance, and to make you sensible, if it may be, of your vanity, your self-conceit, and your arrogance, I have here drawn a line.——

Your table of illustration, for so I think I may call it, does rightly inform us, that the several parts taken together, are equal to the whole; but I beseech you, Mr. Critic, what relation has this equality to what I call the calculated coincidence of the Times? Just as much as the Plasterer's Hawk has to the Carpenter's Handsaw. Do you not perceive that you have stupidly mistaken the interval, and its several distinct parts, for the

the calculated conclusion? And your blunder lies in explaining a self-evident axiom, which needed it not; instead of fixing the attention of the reader upon a most admirable coincidence of the times; which lies, I perceive, as much out of the reach of your comprehension, as the calculations themselves do out of the reach of your abilities.

As you have hereby given me such just cause of offence, and have sunk yourself extremely low in my opinion, I may look upon it as no small matter of concern, that it is not in my power, to bring your skill in practical astronomy, and your justly-suspected abilities, to an open and public trial.

However, to compensate, in some measure, for this defect of power on my part, we will suppose some eminent persons in authority, to address you in the following most gracious and condescending style.

S I R,

We have heard much and often of your fame and reputation, which you have so justly acquired, by your extraordinary proficiency in practical as well as speculative astronomy; this encourages us to expect a proportionable benefit and advantage from it: animated with this persuasion, we make it a matter of request to you, that you would oblige us with a precise definition of the time, in which the moon passes from the moment of her mean opposition, to the moment of her mean conjunction. In other words, we would wish you to define precisely the exact half of the time, in which the moon finishes her mean synodical month. Various definitions have been given, but variety only perplexes. It has been suggested, that such a mathematical definition, as we flatter ourselves with the hopes of from your superior skill, and celebrated accuracy, may happily prove the means, whereby to amend and improve our tables of the moon's mean anomalies, which are the argument, you know, upon which true lunar equations are founded.

Were

Were you actually thus addressed by those who might take the liberty to demand of you some useful specimen of your skill, (and who knows what may happen?) I would immediately step forth, as your Friend, and draw up for you a complete theory of the whole of your procedure; and lay before you such a series of particulars, which, if rightly calculated, every one of them would effectually answer the end proposed.

With this view I give the following numerical scheme, and invite your attention to the several distinct parts of it.

NUME-

NUMERICAL SCHEME.

Table of Radical numbers for F. moons.	<i>Calculation downward.</i> Interval 3807 years. Lunations, 47086.	A. M. 3807. A. J. P. 4513. The year 201 A. C. M. full moon. Month September. Meridian of Alexandria. D. H. / " #	<i>Backward Calculation.</i> Interval 1963 years and 6 months. Lunations 24279 + 6.	A. M. 5771. A. D. 1764. M. full moon Month March. Meridian of Alexandria. D. H. / " #
Table of Radical numbers for N. moons.	Lunations 47086.	☉ in ♌,	☉ in ♏.	M. new moon. Month October. Meridian of Alexandria. D. H. / " #
		O.S.	O.S.	M. new moon. Month March. Meridian of Alexandria. D. H. / " #

Before I explain the purport of this scheme, or draw any inferences from it, I shall here insert two tables.

1st, A TABLE of RADICAL NUMBERS,

For the more easy and accurate calculation of Vernal-Equinoctial M. New Moons, in any given Meridian, and in any given Year, either before or after the vulgar Christian Æra, without any limitation of time.

		D. D. H. ' " "				
After Bissext.	1 Apr.	4 94	4 2 9	37 30	P. M. new moon, first	
	2	4 94	10 2 9	37 30	meridian.	
	3	4 94	16 2 9	37 30		
	0	3 93	22 2 9	37 30		

To this I shall subjoin

A TABLE of RADICAL NUMBERS,

For the more easy and accurate calculation of Vernal-Equinoctial M. Full Moons in any given Meridian, and in any given Year, &c.

		D. D. H. ' " "						
After Bissext.	1 Apr.	18	108	22	24	10	30	P. M. full moon, 1st
	2	19	109	4	24	10	30	meridian.
	3	19	109	10	24	10	30	
	0	18	108	16	24	10	30	

Having constructed these tables, like the preceding one, p. 21. and p. 30, for 4 years, which the present occasion may render necessary; I shall now express my confidence, that the scheme given above, if its distinct particulars be rightly executed, may happily prove the means of entirely ending, not only all disputes, but even every doubt and suspicion concerning the truth or falsity, the accuracy or inaccuracy of all tabular measures, and tabular calculations; and, I may add, concerning likewise the skill of the calculator.

To give you a clear insight into the true grounds of this confidence, take from the outermost column on the right hand, and then from that in the middle, these dates and characters, as follow.

A. M.

A. M. 5771, }
 A. D. 1764. } M. full moon.....☉ in ♑.....M. N. moon, Alexand.
 A. M. 3807, }
 An. A. C. 201 } M. full moon.....☉ in ♈.....M. N. moon, Alexand.

These characters respectively include V. distinct articles to be calculated, namely,

I. The hour and minute of the vernal and the autumnal equinox, in the meridian of Alexandria. II. The M. time of new moon in the same meridian. III. The precise distance of M. new moon *after* the equinoxes. IV. The precise distance of M. full moon, technically called the Epact, *before* the same cardinal points. V. The M. time of full moon, in the same meridian.

Here I must observe, that if the M. distance of new moon *after* the equinoxes, and the M. distance of full moon *before* them, (thus distinctly and separately calculated downward, through a long uninterrupted series of many thousands of lunations) when added together, shall be *exactly equal* to half of the tabular measure of a mean lunation (whatever the assigned measure may be) we may rest assured, that not the least particle of error has crept into any one step of the calculations, but that they are all of them as true as mathematical precision can make them.

On each side of the column in the midst, are explicitly noted the respective intervals; the one for a backward, the other for a downward calculation, to the given new and full moon in the middle column; and if the times, by both the calculations, are found in an exact agreement with each other; I call this exact agreement with each other, an astronomical coincidence of the times. And I dare venture to alledge, that it is the highest instance of perfection in practical astronomy that has ever yet been attained to: notwithstanding your mechanical measure of 5 inches forward, and 7 inches backward, by a foot rule; and that so easily, without having recourse to any tables or calculations at all. Wonderful illustration! Amazing skill! which may be fully displayed upon any joint stool, which is 12 inches in length.

I should

I should be justly liable to censure should I neglect to assure you, that I would not take the liberty (however low you may have sunk yourself in my opinion) to impose a task upon you, which I was neither able nor willing to undertake myself; and you may depend upon my word here given, that the moment you make a public declaration of your inability, or render it manifest by a visible failure in the attempt; I shall immediately step into your place, and endeavour to evince, that what may exceed your ability, may, possibly, not exceed mine.

As they are quite pertinent to the present purpose, I shall cite a few lines from the beginning of my Appendix to VII. Letters addressed to the Reverend Dr. Blair—who chuses, I perceive, to be silent; though I was in hopes that, ere this, I should have found him a zealous opponent: and if I had, I have reason to believe, that his extensive learning and ingenuity would have put all my powers to the stretch, which Mr. Ferguson's imbecillity can never do.

Extract from my APPENDIX to VII. LETTERS addressed to the Reverend Dr. BLAIR.

“ The pillars upon which my System of Chronology
 “ is built, are these few, plain, simple principles ensuing. I. A true luni-solar radix, or determinate
 “ position of the sun and moon to each other at the
 “ creation. II. A true uninterrupted series of years
 “ (both Julian and tropical) collected from the evidences of sacred and prophane history. III. A true
 “ length of the tropical year. IV. A true length of a
 “ mean lunation, or synodical month. V. A true
 “ meridian distance, necessary for a connection of the
 “ first meridian with our own.

“ Now, should any one be actually possessed of
 “ these few principles with a required exactness, would
 “ it not be reasonable to ask, from whence can a sensible error arise?

When

When I consider what operations you have, at present, upon your hands, and what an indispensable accuracy is requisite for the due performance of them, need I say, that it is in my power, upon this occasion, to involve you in the most perplexing difficulties, out of which you would never be able to extricate yourself, without my friendly interposition, and helping hand; and all this, by only retorting upon you your own magisterial style, and saying to you, almost in your own words to me—"You will undoubtedly abide
" by your own tabular measure of a M. lunation, and
" to it I will now bind you down."

Viz. 29d. 12h. 44' 3" 2^m 58^m 19^m 12^m.—See Crit. Review, for May 1763, p. 341.

You adopted, you say, this length of a mean lunation upon the authority of the Reverend Dr. Pound; it being likewise recommended to your approbation and choice, by the express declaration of the late Rev. Dr. Bradley in its favour; who would, you think, have suppressed it, for his friend's sake, if he had not been assured of its truth.

Well then; since you can plead so good authority for it, continue to adopt it still; make the proposed calculations under its directions, and let us see what it will produce.

I have nothing more to add at present, but my wishes, that in this open and public trial of your practical skill, you may acquit yourself with honour and applause,

J. K.

P. S. Let thus much suffice for the first part of the defence of my System of Chronology, and of my answer to your remarks upon the astronomical part of it.

More is to follow, in my intentions; if a critical examination of what I have here published, does not furnish me with sufficient reasons to suppress it.

With

With respect to your Remarks, I have much to reprove you for, and I have much to teach you. If, therefore, you are not unwilling to be reproved, where blameable; or instructed where ignorant; then encourage my coming forth again, as much as in you lies. If you are, then exert your best endeavours to prevent it.

N. B. As I am in your own opinion, and by your own express testimony, a Perfect Man—I cannot allow you to curtail the Reverend Dr. Pound's most elaborate definition; nor can I dispense with a single moment either of excess or defect in the half of his *M. lutation*, which you are to ascertain, with a mathematical exactness, by calculation. Now, if you can perform the prescribed operations, under these necessary restrictions, you will thereby give a full proof to the public, that you are indeed an artist, and are thoroughly qualified to write Critical Remarks on the astronomical part of Kennedy's System of Chronology.

J. K.

THE END.



